An Annotated Bibliography of Pigeonpea Diseases 1906-81

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1985

Contents

Preface

This bibliography has been published to provide annotated information about selected publications concerning pigeonpea diseases in retrospective support of the abstracts published since 1982 in the International Pigeonpea Newsletter (also published by ICRISAT).

This compilation is not comprehensive, but it lists the more important documents of which the authors have become aware during their work at ICRISAT Center and elsewhere. For fuller information readers should consult information available from the Commonwealth Agricultural Bureaux (e.g., via the internationally accessible Dialog data base) or from FAO (via the AGRIS data base).

Language abbreviations used in the citations are as follows:

De = German	Es = Spanish	Fr = French
It = Italian	Pt = Portuguese	

The authors gratefully acknowledge assistance given in the compilation of this bibliography by R. Narsing Rao, S. Prasannalakshmi, S. Varma, J.B. Wills, and N. Raghavan.

Bibliographical Entries

1. ABOUL-EID, H.Z., and GHORAB, A.I. 1974. Pathological effects of Heterodera cajani on cowpea. Plant Disease Reporter 58: 1130-1133.

   A population of Heterodera cajani in Egypt caused the following effects on cowpea (Vigna unguiculata spp unguiculata cv Balady): a retardation in the emergence of leaves, a retardation in the emergence and reduction in number of flowering buds, colored flowers, growing pods, and yield, and reduction in plant height. Feeding of H. cajani on cowpea roots was proved by the formation of typical syncytia. Several histological malformations in cowpea roots were photographed and described.

2. ABRAMS, R., MORALES, A., and JULIA, F.J. 1978. Status of research on pigeonpeas in Puerto Rico. Tropical Grain Legume Bulletin 11-12:17.

   Diseases reported to be important in Puerto Rico are stem canker (Phytophthora parasitica), rust (Uromyces dolicholi), and foliar diseases caused by Colletotrichum sp, Phoma sp, and Cercospora sp. A disease (witches' broom?), probably caused by mycoplasma, is spreading throughout the island.

3. ACLAND, J.D. 1971. East African crops. London, UK: Longman. pp.140-141.

   The yields of pigeonpea are seldom seriously reduced by disease. An exception is the incidence of fusarium wilt (a fungal disease caused by Fusarium udum), which is common in Kenya. Crop rotation is the only method of avoiding fusarium wilt.

4. ADSUAR, J. 1964. A mosaic disease of cowpea (Vigna sinensis Savi) in Puerto Rico. Journal of Agriculture of the University of Puerto Rico 48:264.

   A virus isolated from cowpea plants with mottled, misshapen, and dwarfed leaves was inactivated by dilution to 1:10,000, heating to 60°C for 10 min, or by storage in vitro for 48 h at 28-30°C. The virus was also transmitted to pigeonpea, Canavalia ensiformis, Desmodium distortum, and D. gyroides. The relationship of this virus to others infecting cowpea is being investigated.

5. AGARWAL, G.P., NEMA, K.G., and BELIRAM, R. 1959. Fungi causing plant diseases at Jabalpur (Madhya Pradesh). Pt 1. Proceedings of the National Academy of Sciences of India, Section B 29:314.

   Pathogens found in and around Jabalpur on cultivated and wild plants are listed with host names. The list includes wilt (F. udum) of pigeonpea.

6. AGNIHOTHRUDU, V. 1953. Soil conditions and root diseases. Pt 8. Rhizosphere microflora of some of the important crop plants of south India. Proceedings of the Indian Academy of Sciences, Section B 37:1-13.

   Various fungi were isolated from the rhizosphere soil of pigeonpea, including Fusarium spp.

7. AGNIHOTHRUDU, V. 1955. Incidence of fungistatic organisms in the rhizosphere of pigeonpea (*Cajanus cajan*) in relation to resistance and susceptibility to wilt caused by *Fusarium udum* Butler. Naturwissenschaften 42:1-2.

Abundant *Streptomyces griseolus* was isolated from the colonies of resistant plants. *S. erythrochromogenus* and an unidentified species were also inhibitory. Actinomycetes thus isolated exerted maximum inhibition of *F. udum* on a medium prepared with root extracts of the resistant strain, but were only weakly antagonistic on root extracts medium of the susceptible strain. *F. udum* survived for shorter periods in the rhizosphere soil of resistant plants than of susceptible plants.

8. AGNIHOTHRUDU, V. 1957. The density of the rhizosphere microflora of pigeonpea (*Cajanus cajan* [L.] Millsp.) in relation to the wilt caused by *Fusarium udum* (*F. merismoides*) Butler. Naturwissenschaften 44:497.

The rhizosphere population of pigeonpea increased in number in the presence of *F. merismoides*, the number of fungi decreasing but the number of bacteria increasing greatly. The rhizosphere of wilted and dying plants, however, contained a greater number of fungi than bacteria. The microfloral population in the rhizosphere of wilt-susceptible pigeonpea strains was larger than that of wilt-resistant plants; at higher levels of moisture there was no difference, which may be due to high moisture levels causing errors in soil sampling.

9. AHMED, T. 1974. Rhizoctonia seedling blight of pigeonpea and its control. M.Sc. thesis. Bidhan Chandra Krishi Vishwa Vidyalaya, Kalyani, West Bengal, India.

10. AKINOLA, J.O., and WHITEMAN, P.C. 1972. A numerical classification of *Cajanus cajan* (L.) Millsp. accessions based on morphological and agronomic attributes. Australian Journal of Agricultural Research 23:995-1005.

The commonest disease at the experiment site was stem rot due to *Sclerotinia* sp. Susceptibility to this disease was greatest in accessions having yellow petals with light red veins, and non-hard brown seed. All the accessions with completely red standard petals on the dorsal surface were unaffected by *Sclerotinia*, although all types with red dorsal standard petals may not be *Sclerotinia*-resistant. Further testing of these types should be undertaken if selections and breeding for resistance is required.

11. AKINOLA, J.O., WHITEMAN, P.C., and WALLIS, E.S. 1975. The agronomy of pigeonpea (*Cajanus cajan*). Review Series, Commonwealth Bureau of Pastures and Field Crops no. 1/1975. Farnham Royal, Slough, UK: Commonwealth Agricultural Bureaux. 57 pp.

A Commonwealth Agricultural Bureaux publication that includes a review of pigeonpea diseases and their control.

12. ALAM, M. 1931. Report, Department of Agriculture, Bihar and Orissa 1930-31. pp.42-65.

Sabour 2E "Rahar" selection has given great satisfaction because of its wilt and sterility (cause unknown) resistance. The incidence and severity of sterility disease have been found to vary considerably from year to year and

are believed to depend on external factors. Some of the best Sabour types of pigeonpea have been found resistant to sterility. A strain from Pusa, almost as prolific as the high-yielding Sabour 7S and Pusa P, proved resistant to wilt even after artificial inoculation.

13. ALLEN, D.J. 1979. New disease records from grain legumes. FAO Plant Protection Bulletin 27:134-136.

Halo blight caused by Pseudomonas sp aff. phaseolicola on pigeonpea was reported from Ethiopia. This isolate was pathogenic to pigeonpea and groundnut but not to Phaseolus spp.

14. ALVAREZ, G.L.A. 1960. Phoma canker of pigeonpeas in Puerto Rico. Journal of Agriculture of the University of Puerto Rico 44:28-30.

A Phoma sp isolated from the cankers was characterized by papillate pycnidia of variable size. The pycnidiospores averaged 4 x 1.5 µ. The disease was reproduced by inoculation.

15. AMIN, K.S., BALDEV, B., and WILLIAMS, F.J. 1976. Differentiation of Phytophthora stem blight from Fusarium wilt of pigeonpea by field symptoms. FAO Plant Protection Bulletin 24: 123-124.

Differences and similarities in field symptoms of the two diseases are discussed from the viewpoint of diagnosis. Plants affected by wilt (F. udum) show dark brown to purple streak extending upward from soil level. Stems affected by blight (Phytophthora sp) show a girdling necrotic lesion extending several centimeters up the stem from soil level, and lesions can be found on upper parts also. In wilt older xylem is discolored but in blight it is clear.

16. AMIN, K.S., BALDEV, B., and WILLIAMS, F.J. 1978. Phytophthora cajani, a new species causing stem blight of Cajanus cajan. Mycologia 70:171-176.

Phytophthora cajani, a new species causing stem blight of pigeonpea is described. The characteristics of the pathogen and its taxonomic position in the genus Phytophthora are also discussed.

17. ANGUS, A. 1962. Annotated list of plant pests and diseases in Zambia. Pt. 1. Plant Pathologist's report. Chilanga, Zambia: Mt. Makulu Research Station. p.21.

Cercospora cajani and Meloidogyne javanica are recorded on pigeonpea in Zambia.

18. ANIL KUMAR, T.B., HIREMATH, P.C., and SULLADMATH, V.V. 1976. Fungicidal control of foot-rot of pigeonpea. Current Research 5:98-99.

Maximum protection against Sclerotium rolfsii was obtained using captan as a soil drench. Thiram and brassicol gave good control both as a seed dresser and a soil drench. Ceresan wet and captan were not effective as seed dressers. None of the fungicides tested gave complete control.

19. ANONYMOUS. 1917. A collar disease of pigeonpeas. Agriculture News (Barbados) 16:78.

A collar rot disease of pigeonpea has been reported from the island of Carriacou in the Grenadines. Although the disease is unevenly distributed, it appears to be responsible for the mortality of as many as 50 plants per acre. An ascomycetous fungus was consistently associated with lesions in the collar region of diseased pigeonpea plants. Pycnidia and perithecia of the fungus developed in the bark of affected areas. The pycnospores and ascospores of this ascomycete were unicellular and hyaline. The pathogenicity of the fungus to pigeonpea has yet to be tested. Root and stem diseases of pigeonpea were common on the islands in the Grenadines.

20. ANONYMOUS. 1931. Review of Agricultural Operations in India, 1928-29. Pusa: Imperial Council of Agricultural Research. 251 pp.

The isolation of productive wilt-resistant varieties of pigeonpea and the discovery of certain types of pigeonpea resistant to an unknown sterility disease are described.

21. ANONYMOUS. 1940. Pigeonpea. Indian Farming 1:178.

Pigeonpea, one of the most important food pulses of India, suffers severely from wilt or ukhra, the fungus disease caused by *F. vasinfectum*. Studies showed that varieties differ in their ability to withstand the attacks of the fungus, resistant varieties not being high-yielding and of good cooking quality. An attempt is being made to isolate a wilt-resistant strain from the variety Imperial Pusa 69 that, except for its susceptibility to wilt, is ideal for eating and has other important qualities.

22. ANONYMOUS. 1941. Agriculture and Animal Husbandry in India 1938-39. Delhi: Imperial Council of Agricultural Research. 422 pp.

A wilt-resistant strain of pigeonpea was isolated at Pusa.

23. ANONYMOUS. 1947. Report on the Administration of the Department of Agriculture, United Provinces (India), 1944-45. 86 pp.

Work on pulses included pigeonpea. About 600 selections, representing an all-India collection of pigeonpea varieties, were studied. Some types showed promise of special wilt resistance, hardiness, and high yield.

24. ANONYMOUS. 1947. Plant pathology, plant physiology, entomology, and vegetable crops. Report, Hawaii Agricultural Experiment Station, 1944-46. pp.67-145.

A fungus, probably *Stemphyllium* sp, caused leaf spot of pigeonpea, particularly on variety Mauritius. Pot tests with mycelium produced severe spotting and defoliation.

25. ANONYMOUS. 1948. Report of the Division of Mycology. Scientific Reports of the Indian Agricultural Research Institute, 1945-46. pp.79-88.

For the third successive year pigeonpea varieties IP-80 and IP-41 proved resistant to *F. udum* in inoculation tests.

26. ANONYMOUS. 1949. Report, Department of Agriculture, Uttar Pradesh, 1947-48.

Variety 17W/2, resistant to *F. udum* wilt, was distributed. Mixed cultivation of pigeonpea and sorghum reduced wilt, although another wilt appeared. A different strain of F. udum was isolated.

27. ANONYMOUS. 1950. Report of the Division of Mycology and Plant Pathology. Scientific Reports of the Indian Agricultural Research Institute, 1947-48. pp.145-160.

A summary of work on F. udum wilt.

28. ANONYMOUS. 1950. Report, Department of Agriculture, Uttar Pradesh, 1948-49. 125 pp.

The wilt-resistant strain of pigeonpea, 17W/2, was chosen for multiplication to replace the susceptible strain 66; selection of other resistant types continued.

29. ANONYMOUS. 1951. Report of the Division of Mycology and Plant Pathology. Scientific Reports of the Indian Agricultural Research Institute, 1948-49. pp.177-190.

Of 19 pigeonpea varieties tested, NP-41, CO-15, W.Exp., Very Early, C-38-3-1, and NP-69 x UP-132-F 4-18 B appeared to be resistant to wilt.

30. ANONYMOUS. 1952. Report of the Division of Mycology and Plant Pathology. Scientific Reports of the Indian Agricultural Research Institute, 1949-50. pp.81-88.

Varietal response to F. udum was observed in field and pot tests. Presence in the soil of Rhizopus nigricans and Cunninghamella elegans reduced pathogenicity of fungus.

31. ANONYMOUS. 1952. List of intercepted plant pests, 1951. Washington, D.C., USA: US Department of Agriculture. p.61.

Colletotrichum cajani was intercepted on a flight from Puerto Rico to USA.

32. ANONYMOUS. 1953. Report of the Division of Mycology and Plant Pathology. Scientific Reports of the Indian Agricultural Research Institute, 1950-51. pp.89-99.

Pigeonpea varieties NP-41, C 38-1-2, and D 419-2-4 were highly resistant in two tests against F. udum.

33. ANONYMOUS. 1954. Report of the Division of Mycology and Plant Pathology. Scientific Reports of the Indian Agricultural Research Institute, 1951-52. pp.75-87.

Field and pot tests were carried out for resistance to wilt.

34. ANONYMOUS. 1954. Report of the Division of Mycology and Plant Pathology. Scientific Reports of the Indian Agricultural Research Institute, 1952-53. pp.78-89.

The pigeonpea varieties NP-41, C 15-WE, and C 38-3-1 were resistant to wilt (F. udum) both in field and pots. The passage through soil of a culture filtrate of B. subtilis resulted in a loss of antibiotic activity. The antibiotic was extracted by adsorption of kaolin and elution with ethyl alcohol. It was found to be thermostable, giving positive biuret and xanthoproteic reactions, and active at pH 4.5-9.8. At conc. 1:10,000 the growth of F. udum was inhibited.

35. ANONYMOUS. 1954. Agricultural Research. Report, Indian Council of Agricultural Research, 1951-52. pp.11-53.

Four selections of pigeonpea resistant to wilt (F. udum) were made in Bombay; Yadgir No. 3 and C-11 in Hyderabad; and Type 17 for moderate resistance in Uttar Pradesh.

36. ANONYMOUS. 1955. Report of the Division of Mycology and Plant Pathology. Scientific Reports of the Indian Agricultural Research Institute, 1953-54. pp.87-99.

Field and pot experiments showed that the pigeonpea variety NP-69 x UP-132-3-2-2-2 was resistant to F. udum. The variety NP-41 has shown high resistance since 1945.

37. ANONYMOUS. 1963. Plant pathology. Report of the Department of Agriculture, Papua New Guinea, 1960-61. pp.74-79.

Witches' broom of pigeonpea is under further investigation.

38. ANONYMOUS. 1964. Mycology and Plant Pathology Section. Agricultural Research (India) 4:209-222.

Infection by sterility virus appeared to give some protection against F. udum wilt. Sap from infected plants inhibited germination of Fusarium conidia.

39. ANONYMOUS. 1965. Improved crop varieties and their yields. Indian Farming 15:35-38.

Some improved varieties of crop plants evolved by the IARI are given. In pigeonpea the varieties listed are NP(WR)-15 and NP(WR)-18. Both are late-maturing, high-yielding, and wilt-resistant.

40. ANONYMOUS. 1968. Green manure. Seed World 103:22.

Pigeonpea cv Norman has been developed as a new green manure crop for North and South Carolina, USA. In trials during 4 years, average yields from Norman were 3.75 tons DM/acre (8407 kg/ha), compared with 2.5 tons DM/acre (5605 kg/ha) from Crotalaria and hairy indigo (Indigofera hirsuta). Norman is resistant to the two main root-knot nematodes (Meloidogyne spp) found in North Carolina.

41. ANONYMOUS. 1973. Report of the Faculty of Agriculture, 1971-72. St. Augustine, Trinidad; Trinidad and Tobago: University of West Indies.

Three types of infection by Puccinia sp were observed in F2s of pigeonpea crosses. One type, observed in two plants, gave indications of incipient resistance.

42. ANONYMOUS. 1976. Testing of arhar (pigeonpea) strains against wilt disease. Pesticides 10:17.

The entries identified as resistant to wilt are: 15-3-3, DT-236-6-3-102, (C-11 x N-252), (C-11 x N-252)-10, Vita-1, Osmanabad-1-5, and Udgir-500. Fungicidal and biological methods of control of wilt are also being studied.

43. APONTE APONTE, F. 1963. [Cultivation of pigeonpea in Puerto Rico.] (In Es.). Caribbean Agriculture 1:191-197.

A canker disease caused by Phoma sp affected the stems and branches of pigeonpeas in Puerto Rico. Heavy infection was expected to kill the plants. The use of chemicals to control the disease was not investigated. Recommended controls are the use of healthy seed and the destruction of crop residues as soon as harvesting is completed. Care should be exercised to avoid damaging plants during cultivation. In areas where the disease is severe, it may be necessary to rotate pigeonpeas with other crops.

44. ARCHIBALD, J.F. 1961. Transmission of gall disease of cacao, mango, and pigeonpea. Nature (UK) 190:284.

Investigations showed that the "green-point" type of cacao cushion-gall could be transmitted by washings of galls and by extracts of macerated gall tissue, using the half-bean technique. Similar galls found on mango and pigeonpea could be transmitted in cacao; part of the galls produced on cacao by inoculation from pigeonpea galls were distinct from galls transmitted from cacao and mango. It is considered inadvisable to grow mango or pigeonpea in close proximity to cacao.

45. ARIYANAYAGAM, R.P. 1975. Status of research on pigeonpea in Trinidad. Pages 131-140 *in* Proceedings of the International Workshop on Grain Legumes, 13-16 Jan 1975. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

Sclerotium rolfsii disease of pigeonpea are described. Semideterminate Indian varieties are listed. Tolerant one are 10/246, 4/95, and 5/119.

46. ARIYANAYAGAM, R.P., and SPENCE, J.A. 1978. Pigeonpea improvement activities at the University of West Indies, Trinidad. Tropical Grain Legume Bulletin 13-14:14-18.

In the Eastern Caribbean pigeonpea rust (*Uredo cajani*) and southern blight (*S. rolfsii*) are encountered. Germplasm tolerant to rust have been identified. An evaluation of the incidence of rust on yield of peas indicated no adverse effects.

47. ARMSTRONG, G.M., and ARMSTRONG, J.K. 1950. Biological races of the *Fusarium* causing wilt of cowpea and soybeans. Phytopathology 40:181-193.

Inoculation produced slight infection of the vascular tissue of pigeonpea.

48. ASHBY, S.C. 1927. *Macrophomina phaseoli* (Maubl.) Comb. Nov: the pycnidial stage of *Rhizoctonia bataticola* (Taub) Butl. Transactions of the British Mycological Society 12:141-147.

The type of *Macrophoma cajani* (Syd. and Butl.) on living stems of pigeonpea from Pusa is included in the synonomy of *Macrophomina phaseoli*.

49. AYALA, A. 1962. Parasitism of bacterial nodules by the reniform nematode. Journal of Agriculture of the University of Puerto Rico 46:67-69.

In greenhouse studies, bacterial nodules on pigeonpea roots were attacked by females of an undescribed species of the reniform nematode, *Rotylenchulus* sp, originally obtained from pigeonpea roots in Puerto Rico.

50. AYALA, A. 1962. Pathogenicity of the reniform nematode on various hosts. Journal of Agriculture of the University of Puerto Rico 46:73-82.

In Puerto Rico, pigeonpea is a preferred host of the reniform nematode, *Rotylenchulus* sp. Bacterial nodules on pigeonpea roots are also attacked by this nematode.

51. AYALA, A. 1962. Occurrence of the nematode *Meloidogyne javanica* on pigeonpea roots in Puerto Rico. Journal of Agriculture of the University of Puerto Rico 46:154-156.

The Javanese root-knot nematode, *M. javanica*, was reported for the first time in Puerto Rico infecting the roots of pigeonpea variety Saragateado at Rio Piedras. Pigeonpea roots were also very susceptible to attack by *Criconemoides* sp., *Helicotylenchus* sp, *Hoplolaimus* sp, and *Rotylenchulus reniformis*.

52. AYALA, A., and RAMIREZ, C.T. 1964. Host-range, distribution, and bibliography of the reniform nematode, *Rotylenchulus reniformis*, with special reference to Puerto Rico. Journal of Agriculture of the University of Puerto Rico 48:140-161.

Eighty-nine plant species were hosts of the reniform nematode in Puerto Rico, 15 of which were new hosts of *Rotylenchulus* spp. and 74 of *R. reniformis*. Pigeonpea was the most susceptible host of the reniform nematode in Puerto Rico.

53. BAGYARAJ, D.J., and RANGASWAMI, G. 1966. On the variations in rhizosphere effects of some crop plants. Current Science 35:238-239.

Among five crops grown in similar conditions pigeonpea had the greatest rhizosphere effect on bacteria.

54. BALDEV, B., and AMIN, K.S. 1974. Studies on the existence of races in *F. udum* causing wilt of *Cajanus cajan*. SABRAO Journal 6:201-205.

A survey of the pigeonpea-growing area in India was undertaken, to study the crop's wilt disease under field conditions and to obtain spot isolations of the fungus. Pot-culture studies using some of these isolates revealed differential responses of pigeonpea varieties and pathogenic races of *F. udum*.

55. BARNES, R.F. 1973. A preliminary list of literature on pigeonpea (*Cajanus cajan* [L.] Millsp.). Plant Pathology Bulletin 1. St. Augustine, Trinidad, Trinidad and Tobago: University of West Indies, Department of Biological

Science. pp. 1-23.

A preliminary list of papers on the pathological aspects of pigeonpea, in which some 184 references from world literature were recorded, is given.

56. BARRETT, O.W. 1925. The food plants of Puerto Rico, 1925. Journal of the Department of Agriculture, Puerto Rico 9:61-208.

Pigeonpea is potentially the most important food and forage crop in Puerto Rico. The author describes various agronomic characters of 20 pigeonpea varieties tested at Trujillo, Puerto Rico, and records the reaction of some varieties to rust. The rust reaction (in parentheses) is as follows: Blanco (highly resistant), Todo Tempo (moderately resistant), Miami or Florida (moderately susceptible), and Chagaros and New Era (very susceptible).

57. BATES, G.R. 1957. Botany and plant pathology. Report of the Ministry of Agriculture, Rhodesia and Nyasaland, 1955-56. pp. 79-86.

A new record of *Cercospora cajani* on pigeonpea is given.

58. BATISTA, A.C., and VITAL, A.F. 1952. [Monograph of the species of *Phyllosticta* in Pernambuco.] (In Pt.) Boletim da Secretaria da Agricultura Pernambuco 19:1-80.

Phyllosticta cajani was reported on pigeonpea in Brazil.

59. BEELEY, F. 1939. A nematode pest of roots of cover plants. Journal of the Rubber Research Institute of Malaya 9:51-58.

In studies with different legume species commonly grown as cover crops in rubber plantations in Malaya, pigeonpeas were found to exhibit some resistance to attack by root-knot nematodes (*Heterodera marioni*). Pigeonpea might prove to be a good cover crop to plant on root-knot nematode-infested land.

60. BESSEY, E.A. 1911. Root-knot and its control. Bulletin, United States Department of Agriculture no.217. 89 pp.

Pigeonpea was found to be a natural host of the root-knot nematode, *Heterodera radicicola* (= *Meloidogyne* sp) in the southern United States. Although nematodes were abundant on pigeonpea roots, injury apparently was not great.

61. BHARAT RAI, UPADHYAY, R.S., and GUPTA, R.C. 1978. Resting body formation by *Fusarium udum* inside sporangiophores of *Rhizopus nigricans* during hyphal parasitism. Microbios Letters 6:125-127.

Colony interaction and hyphal parasitism between *F. udum* and *R. nigricans* were studied. It was observed that *F. udum* grew into *R. nigricans* either above or below the colony. During the hyphal interference, penetration and chlamydospore formation by *F. udum* inside the sporangiophores of *R. nigricans* was observed. The hyphal interference between these fungi was found to be very common.

62. BHARAT RAI, and UPADHYAY, R.S. 1979. Discovery of perfect state of *Fusarium*

udum Butler. Proceedings of the Annual Conference of the Society for Advance Botany 5:25. (Abstract.)

During ecological studies on F. udum the authors found perithecia of an ascomycetous fungus on wilted and dead parts of pigeonpea. The fungus was identified as a new species of Gibberella and proved to be the perfect state of F. udum.

63. BHARAT RAI, and UPADHYAY, R.S. 1979. Micromonospora globosa Krassilnikov: a destructive parasite of Fusarium udum Butler. Microbios Letters 8:123-128.

F. udum, the causal organism of wilt of pigeonpea, was found to be parasitized and destroyed by an actinomycete, M. globosa, in dual cultures. The latter significantly reduced the growth of the former and was proved to be a strong antagonist. During the course of destructive parasitism, coiling and penetration of the host hyphae by the parasitic hyphae were observed, resulting in granulation, coagulation, and vacuolation of the cytoplasm of the host hyphae. Consequently, a large proportion of host hyphae underwent lysis and many chlamydospores were formed. The chlamydospores of F. udum were also attacked by the parasite, resulting in disintegration of their outer walls in an advanced stage of necrotrophic parasitism.

64. BHARGAVA, R.N. 1975. Two new varieties of arhar for Bihar. Indian Farming 25:23.

Pigeonpea Kanke-9, derived from a cross between BR-60 and perennial pigeonpea, is a semierect, medium-maturing, high-yielding variety of good cooking quality. It is resistant to F. udum. Kanke-3 is a selection from a cross between BR-183 and perennial pigeonpea and has a bushy, spreading habit. It matures slightly earlier than Kanke-9 and is of good cooking quality. It is high-yielding and moderately resistant to F. udum and frost.

65. BHARGAVA, S.N. 1965. Studies on the charcoal rot of potato. Phytopathologische Zeitschrift 53:35-44.

Macrophomina phaseoli, isolated from potato, was successfully inoculated into wounded pigeonpea.

66. BHARAGAVA, S.N., and SINGH, A.P. 1978. Survival studies on three species of Fusarium causing wilt of pigeonpea. Page 189 in Abstracts of papers of the Third International Congress of Plant Pathology, 16-23 Aug 1978, Munich, Federal Republic of Germany. Berlin, Federal Republic of Germany: Paul Parey.

Fusarium acuminatum, F. oxysporum, and F. solani were commonly found in pigeonpea soils. Each of these species was found to cause wilt of pigeonpea. Survival studies revealed that the populations of these species were at a maximum at 30% water-holding capacity of the soil and at a temperature between 20°C and 30°C. Addition of carbohydrates to the soil at a 1% rate caused decline in the population of these species within 2-3 weeks, but the decline was more pronounced in the case of soil amended with sucrose. Amending the soil with various nitrogenous sources at a 1% rate indicated that ammonium sulphate and urea decreased the colonies of these species. In the case of soil amended with sodium nitrate the population of F. oxysporum increased. As the C:N ratio was increased the number of colonies of these

species declined in the soil. Among nine fungicides tried (including an antibiotic) Difolatan at 100 ppm was found to be more effective in reducing the population of these species in the soil.

67. BHARGAVA, S.N., SHUKLA, D.N., and DWIVEDI, D.K. 1980. Pod-rots of pea, red gram and Brassica. National Academy Science Letters (India) 3:287.

Rots of pea, pigeonpea, and B. campestris caused by Fusarium solani, Aspergillus flavus, and Curvularia lunata, respectively, are described.

68. BHARGAVA, S.N., SHUKLA, D.N., PANDEY, R.S., and KHATI,D.V.S. 1981. New seedling rot of pigeonpea and sesame (Fusarium equiseti). Acta Botanica Indica 9:131.

69. BHASKARAN, K. 1954. Crops and crop improvement in Hyderabad. Agricultural College Journal, Osmania University 1:60-63.

Pigeonpea, which is believed to have originated in Africa, has been under large-scale cultivation for a long time. Two wilt-resistant strains of pigeonpea, C-11 and C-26, have been released for distribution to farmers.

70. BHATNAGAR, P.S., GANGWAR, L.C., and KUMAR, V. 1966. Phyllody in pigeonpea (Cajanus cajan [L.] Millsp.). Kanpur Agricultural College Magazine 26:51-52.

71. BIRD, J. 1962. A whitefly-transmitted mosaic of Rhynchosia minima and its relation to tobacco leaf curl and other virus diseases of plants in Puerto Rico. Phytopathology 52:286 (Abstract.)

The leguminous weed (R. minima) was affected by a rugaceous mosaic in Puerto Rico. The causal virus could not be mechanically transmitted from diseased to healthy plants of Rhynchosia. A strain of the whitefly Bemisia tabaci is capable of efficiently transmitting the virus from diseased to healthy plants. The host range of the Rhynchosia virus, as determined in the greenhouse, includes several varieties of Nicotiana tabacum and N. glutinosa. Other plant species infected experimentally were Abelmoschus esculentus, Gossypium hirsutum, Phaseolus vulgaris, P. lathyroides, pigeonpea, Canavalia ensiformis, Ipomoea quinquefolia, and Spermacoce tenuior. The symptoms on affected tobacco plants are indistinguishable from those of severe leaf curl disease of tobacco in Puerto Rico. Plants of R. minima (infected with B. tabaci in tobacco fields) have been invariably affected by the severe leaf curl disease. The virus causing mosaic of R. minima is believed to be distinct from the virus responsible for the infectious chlorosis of the Malvaceae and from the virus that causes mosaic of Jatropha gossypifolia in Puerto Rico. The available evidence indicates that malvaceous chlorosis virus and the mosaic of Rhynchosia are transmitted by a race of B. tabaci that is distinct from the one that spreads the Jatropha virus. The Rhynchosia virus seems to be related to whitefly-transmitted bean (double) yellow mosaic virus studied by Capoor and Varma in India.

72. BIRD, J., and SANCHEZ, J. 1971. Whitefly-transmitted virus in Puerto Rico. Journal of Agriculture of the University of Puerto Rico 55:461-467.

In Puerto Rico, pigeonpea is infected naturally by a rugaceous (whitefly-transmitted) disease from R. minima. The pathogen from R. minima has a wide host range in Puerto Rico where it produces a mosaic disease in pigeonpea.

73. BIRD, J., SANCHEZ, J., RODRIGUEZ, R.L., and JULIA, F.J. 1975. Rugaceous (whitefly-transmitted) viruses in Puerto Rico. Pages 3-25 in Tropical diseases of legumes, (Bird, J., and Maramorosch, K., eds.). New York, USA: Academic Press.

The causal agent of a mosaic disease of R. minima, thought to be a virus or viroid, affects pigeonpea naturally in Puerto Rico. The Rhynchosia mosaic pathogen, which is transmitted by whiteflies (B. tabaci), produces a yellow mosaic symptom in pigeonpea.

74. BISHT, N.S., and BANERJEE, A.K. 1965. Occurrence of two new virus diseases in Uttar Pradesh. Labdev Journal of Science and Technology 3:271-272.

Mosaic disease of pigeonpea affected 10% of the crop with both mild and severe symptoms, confined to the trifoliate leaves of the upper branches. On young leaves faint, scattered, green and yellow spots gradually developed into a severe mosaic. Leaf size was not affected but small, poorly developed green pods producing small shrivelled seeds were found on heavily infected plants. The disease was transmitted to pigeonpea by grafting, but not to cowpea, Phaseolus aureus or P. mungo. Three common insect vectors failed to transmit the virus (which does not resemble pigeonpea sterility and appears to be new).

75. BOCK, K.R. 1971. Notes on East African plant virus diseases. 1. Cowpea mosaic virus. East African Agricultural and Forestry Journal 37:60-62.

A beetle-transmitted virus with spherical particles was isolated from naturally-infected cowpeas (Vigna unguiculata) in the coastal region of Kenya. The virus was identified as the yellow mosaic or Nigerian strain of cowpea mosaic virus (CPMV). The beetle vector of CPMV in Kenya is Ootheca mutabilis. In mechanical inoculation studies pigeonpeas were susceptible to CPMV. Pigeonpeas are widely grown as a perennial in the coastal regions of Kenya. It is probable that pigeonpeas serve as a reservoir of the virus.

76. BOCK, K.R. 1973. East African strains of cowpea aphid-borne mosaic virus. Annals of Applied Biology 74:75-83.

Pigeonpeas were susceptible to infection by two of three East African strains of cowpea aphid-borne mosaic virus in greenhouse inoculation tests. The virus was systemic but symptomless in pigeonpea.

77. BOCK, K.R., GUTHRIE, E.J., and KULKARNI, H.Y. 1973. Notes on East African plant virus diseases. 2. Pea mosaic virus. East African Agricultural and Forestry Journal 39:77-81.

An isolate of pea mosaic virus (PMV), a strain of bean yellow mosaic virus, was isolated from diseased broad beans (Vicia faba) growing in the highlands of Kenya. Pigeonpeas were susceptible to the broad bean isolate of PMV.

78. BOCK, K.R., GUTHRIE, E.J., and MEREDITH, G. 1977. Clitoria yellow vein virus, a tymovirus from Kenya. Annals of Applied Biology 85:97-103.

Clitoria yellow vein virus (CYVV), a tymovirus, was isolated from the wild legume Clitoria ternatea in the coastal region of Kenya. Pigeonpeas were very susceptible to CYVV in greenhouse inoculation tests. Symptoms exhibited by CYVV-infected pigeonpeas were stunting of the plant and persistent systemic chlorotic vein net of the foliage. The virus is potentially very important to all food legumes grown in the coastal areas of Kenya.

79. BOOTH, C. 1971. The genus Fusarium. Kew, Surrey, UK: Commonwealth Mycological Institute. p.114.

Fusarium udum causes a vascular wilt of pigeonpea and has been reported from Germany, Italy, India, Tanzania, Uganda, and Vietnam.

80. BOSE, R.D. 1938. The rotation of tobacco for the prevention of wilt disease in pigeonpeas (Cajanus cajan [L.] Millsp.). Agriculture and Livestock in India 8:653-668.

Control of Fusarium wilt in pigeonpeas was shown in field experiments with tobacco rotation over several years using highly susceptible variety Pusa type 5.

81. BRATHWAITE, C.W.D. 1978. Inhibition of Sclerotium rolfsii by Pseudomonas aeruginosa and Bacillus subtilis and its significance in the biological control of Southern blight of pigeonpea (Cajanus cajan [L.] Millsp.). Page 197 in Abstracts of papers of the Third International Congress of Plant Pathology, 16-23 Aug 1978, Munich, Federal Republic of Germany. Berlin, Federal Republic of Germany: Paul Parey.

Germination of sclerotia, growth, and sclerotia production by S. rolfsii Sacc. was inhibited by both P. aeruginosa (Schroeter) Migula and B. subtilis in culture and in soil. Inhibition in soil was demonstrated by the use of a new soil-agar plate technique. Inoculation of fungus-infested soil with both bacteria prior to planting seed of pigeonpea resulted in increased seedling emergence and reduced blight. Preliminary evidence is presented which indicates that inhibition of S. rolfsii by P. aeruginosa is associated with the production of the antibiotic, pyocyanine.

82. BRATHWAITE, C.W.D. 1981. Diseases of pigeonpea in the Caribbean region. Pages 129-136 in Proceedings of the International Workshop on Pigeonpeas, 15-19 Dec 1980, ICRISAT Center, V.1. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

Pigeonpea, with a seed protein content of up to 24%, contributes significantly to the nutrition of the Caribbean people. However, crop yields are low, on average. Diseases are among the major yield-reducers. Twenty-one have been reported from the area, and this paper surveys available literature on the most serious ones.

83. BRIANT, A.K., and MARTYN, E.B. 1929. Diseases of cover crops. Tropical Agriculture 6:258-260.

Sunn hemp wilt fungus, indistinguishable from F. vasinfectum, does not appear to attack pigeonpea or cowpea. A common disease of pigeonpea is caused by Uromyces dolicholi and a stem canker by sterile hyphae.

84. BRIDGE, J. 1973. Hoplolaimus seinhorsti, an endoparasitic nematode of cowpea in Nigeria. Plant Disease Reporter 57: 798-799.

At Ibadan, Nigeria, the parasitic nematode H. seinhorsti was found to be endoparasitic in the roots of several food crops, including pigeonpea.

85. BUGNICOURT, F. 1956. [Parasitic fungi of cultivated plants in New Caledonia.] (In Fr.) Noumida, France: Institut Francais d'Oceanie. 23 pp.

Corticium salmonicolor is reported on pigeonpea.

86. BUTLER, E.J. 1906. The wilt disease of pigeonpea and pepper. Agricultural Journal of India 1:25-36.

The wilt disease of pigeonpea is responsible for 15-25% mortality of plants, and the figure may rise to more than 50% in epidemic years. The disease appears on young seedlings in August and the highest mortality in mature plants is caused at flowering time in November and December. This disease progresses in patches; its symptoms are described.

87. BUTLER, E.J. 1908. Selection of pigeonpea for wilt disease. Agricultural Journal of India 3:182-183.

The experiments were conducted to identify a strain of pigeonpea resistant to wilt disease. A number of strains were collected and tested in a plot severely infected with fungus. A few of these collections showed promise and were found to be somewhat resistant.

88. BUTLER, E.J. 1910. The wilt disease of pigeonpea and the parasitism of Neocosmospora vasinfecta Smith. Memoirs of the Department of Agriculture in India, Botanical Series 2:1-64.

The name F. udum is proposed for the causal organism of pigeonpea wilt and its characters are described. The method of breeding resistant strains is also discussed.

89. BUTLER, E.J. 1926. The wilt diseases of cotton and sesamum in India. Agricultural Journal of India 21:268-273.

A detailed description is given of artificial inoculations of seedlings of both hosts with the organisms isolated from wilted plants, the results of which, together with the morphological and cultural features of the pathogen, lead the author to consider that the wilt-producing fungi attacking cotton, sesamum, and pigeonpea in India are specialized strains of F. vasinfectum, the American cotton wilt organism.

90. CAPOOR, S.P. 1950. Report on pigeonpea sterility with symptoms and transmission. Proceedings of the Indian Science Congress 37 (pt.3):56-59.

The symptom expression of the disease, its behavior, and the experimental evidence presented are characteristic of a virus disease. The disease is readily transmitted by graft inoculation, but only in a few cases by the inoculation of juice extracted from the leaves of diseased plants.

91. CAPOOR, S.P. 1952. Observation on the sterility disease of pigeonpea in

Bombay. Indian Journal of Agricultural Sciences 22:271-274.

The symptom expression of the disease, its behavior under field conditions as well as in the glasshouse, and experimental evidence are all characteristic of a virus disease. The disease is readily transmitted by graft inoculation, but only in a few cases by the inoculation of juice extracted from leaves of diseased plants. It is proposed that the causal virus of sterility disease be called the "pigeonpea sterility mosaic virus."

92. CAVENESS, F.E. 1974. Plant parasitic nematode population differences under no-tillage and tillage soil regimes in Western Nigeria. Journal of Nematology 6:138. (Abstract.)

Pigeonpea, soybean, and cowpea following six continuous crops of maize reduced the number of Pratylenchus spp under both soil management regimes. Tillage soils had more than twice the number of Pratylenchus spp than nontillage soils when grown to pigeonpea and soybean.

93. CHADHA, K.C., and RAYCHAUDHURI, S.P. 1965. Interaction between sterility virus and Fusarium udum Butl. in pigeonpea. Indian Journal of Agricultural Sciences 36:133-139.

Laboratory experiments showed inhibition of growth and spore germination of F. udum in potato dextrose agar + extract of virus-infected pigeonpea. Chromatography showed no glutamic acid or alanine in infected plants.

94. CHAKRABARTI, S., and NANDI, P. 1969. Effect of griseofulvin in Fusarium udum Butler and its host pigeonpea (Cajanus cajan [L.] Millsp.). Proceedings of the Indian Science Congress 56:288. (Abstract.)

Use of griseofulvin was found to be highly effective against F. udum. Growth of the fungus was inhibited by a very low concentration of this antibiotic. Conidial germination was not hindered, even by higher concentrations, but the germ tube was affected. Griseofulvin did not retard growth of seedlings but lower concentrations (2.5 μg/ml to 0.1 μg/ml) stimulated growth. The shoot was noticeably affected at concentrations above 10 μg/ml. There was rolling and mottling of the leaves at higher concentrations. In the presence of the antibiotic, roots became excessively branched, curled, and hairy; root stunting was observed from 5 μg/ml and above.

95. CHARYA, M.A.S., and REDDY, S.M. 1979. Studies on seed microflora of Cajanus cajan Millsp. Geobios 6:299-301.

More fungi were found on the local pigeonpea cultivars than on three hybrid ones. The blotting paper technique revealed more seed-borne species than the agar plate method.

96. CHARYA, M.A.S., and REDDY, S.M. 1980. Effect of Cajanus cajan seed coat leachates on germination of some seed-borne fungi. Indian Phytopathology 33:112-113.

The seed coat is the common site of infection of most seed- transmitted fungi imperfecti. The seed coat leachates have been reported to have an inhibitory effect on certain seed-borne fungi. Literature exists on the production and

effect of seed coat leachates of oilseed crops. However, very little work has been done on pulse seed coat leachates. An attempt was therefore made to investigate the effect of pigeonpea seed coat leachates against some seed-borne fungi. All the test fungi were isolated from pulse seeds collected from Warangal grain market. Leachates were tested for their fungal toxicity by the humid glass chamber technique. The results showed that percentage germination inhibition of spore germination of Culvularia geniculata (88.6), F. oxysporum (74.5), and Drechslera hawaiiensis (70.5) was significantly reduced by the seed coat leachates while Aspergillus flavus (20.5) and Corynespora cassiicola (21.3) were least affected. The remaining, Alternaria alternata (25.4), Drechslera rostrata (29.3), Penicillium capsulatum (32.4), Phaeotrichoconis crotalariae (24.4), and Rhizopus stolonifer (44.2) were intermediate in their response. The inhibitory action of seed coat leachates on fungal spore germination may be due to the presence of certain antifungal substances in the seed coat. These substances may be acting as defensive agents against seed infection.

97. CHATTOPADHYAY, S.B., and SENGUPTA, P.K. 1967. Studies on wilt diseases of pulses. I. Variation and taxonomy of Fusarium species associated with wilt disease of pulses. Indian Journal of Mycological Research 5:45-53.

A number of isolates of Fusarium inciting wilt in pigeonpea were studied along with their variants produced on monoconidial cultures on three different media, namely potato dextrose agar, oat-meal agar, and steamed rice. Variations in cultural characters -- e.g., amount of aerial mycelium, texture, strength, production of sporodochia and sclerotia were noted among the different isolates and their variants. The naming of F. udum as F. oxysporum f. udum proposed by Snyder and Hansen (1940) was supported.

98. CHAUBE, H.S. 1968. Combating diseases of arhar and gram. Indian Farmers' Digest 1:26-27.

A number of pulse crops are grown in India. Most of the diseases attacking these crops can be effectively controlled by suitable protective measures at the right time. The pigeonpea diseases discussed are wilt and sterility mosaic. Wilt disease becomes apparent when the plants are 5-6 weeks old. Vascular tissues of the lower stem and roots are blackened in streaks or patches. This discoloration is clearly visible when the bark of the lower stem is peeled off. Losses from this disease can be minimized by growing wilt-resistant varieties such as NP(WR)-15, -16, and -42.

99. CHAUDHARY, S.K., and PRASAD, M. 1974. Variations in sugar contents of healthy and Fusarium oxysporum f. udum infected plants of Cajanus cajan. Phytopathologische Zeitschrift 80:303-305.

After infection by F. oxysporum f. sp. udum (F. udum) a rapid depletion of glucose, fructose, maltose, and raffinose was detected in roots and shoots of pigeonpea varieties. The highly susceptible Early 269 and Early 358, in which amounts of glucose and sucrose were initially excessive, showed the most rapid loss.

100. CHAUDHARY, S.K., and PRASAD, M. 1975. Effects of micronutrients and intermittent sunlight on growth and sporulation of Fusarium oxysporum f. udum. Phytopathologische Zeitschrift 82: 287-290.

Copper was the strongest inhibitor of *F. oxysporum* f.sp. *udum* (*F. udum*). Mo, Zn, Fe, and Mn together stimulated growth and sporulation in the absence of Cu. In the presence of Cu, they contributed to inhibition in varying degrees. The trace elements generally reduced the size of all three spore forms. Intermittent exposure to sunlight for 24 h during the 4 weeks of incubation decreased mycelial growth and macroconidia but increased production of microconidia and chlamydospores.

101. CHAUDHURI, S., and AHMED, T. 1977. Fungicides for the control of Rhizoctonia seedling blight of pigeonpea. Pesticides 11:23-25.

During the 40-day period of crop growth, effective protection against *Macrophomina phaseolina* on pigeonpea was given by Campogran M at 1.5 g/kg seed, Allisan at 2.5 g/kg, and Busan 72 at 0.3 g/kg.

102. CHILDERS, N.F., WINTERS, H.F., ROBLES, P.S., and PLANK, H.K. 1950. Vegetable gardening in the tropics. Circular no. 32. Mayaguez, Puerto Rico: United States Department of Agriculture, Federal Experimental Station. 144 pp.

Pigeonpea is an important perennial food legume in the tropics. Damping-off of pigeonpea seedlings may be a problem if the planting season turns cool and moist. Anthracnose, rust, leaf spots, and a collar and stem canker are occasionally troublesome.

103. CIFERRI, R. 1927. [Report on Phytopathology. Principal diseases of cultivated plants observed during the year 1926.] (In Es.) Informe Annual, Estacion, Agronomica de Moca, Republica Dominicana 2:36-44.

Pigeonpeas are attacked by *Cercospora cajani*.

104. CIFERRI, R., and GONZALEZ, FRAGOSO R. 1927. [Parasitic and saprophytic fungi of the Dominican Republic (10th Series).] (In Es.) Boletin de la Real Sociedad Espinola de Historia Natural 27:165-177.

Cercospora cajani was found on living pigeonpea leaves.

105. COLLINS, J.C. 1938. Nematode investigations. Rhodesia Agricultural Journal 35:431-438.

In Southern Rhodesia pigeonpeas were one of several crops found to be host of the root-knot nematode (*Heterodera marioni*) when planted in tobacco fields heavily infested with the nematode.

106. COMMONWEALTH MYCOLOGICAL INSTITUTE. 1951. Distribution maps of plant diseases. Map 236. Kew, Surrey, UK: CMI.

The map shows the distribution of *Uromyces dolicholi*.

107. COOK, M.T. 1939. [Diseases of economic plants in the Antilles.] (In Es.) Monograph Series B no. 4. Rio Piedras, Puerto Rico: University of Puerto Rico. 530 pp.

In the Antilles region of the Caribbean several diseases have been reported to affect pigeonpeas but very few studies of them have been conducted. Anthracnose (*Colletotrichum cajani*) is an important disease, particularly of

the pods. Rust (Uromyces dolicholi) is a very destructive disease of some pigeonpea varieties in the Antilles. The most widespread and common leaf spot disease of pigeonpea in the region is caused by Cercospora cajani. In Puerto Rico a similar disease is caused by Botryosphaeria xanthocephala (= Physalospora xanthocephala). Sclerotium sp causes a serious stem disease in Puerto Rico. Some diseases affecting pigonpeas do not occur in the Antilles region. These include Phyllosticta leaf spot (P. cajani), foliar anthracnose (Colletotrichum cajani), and a stem and root disease caused by Phoma cajani and Rosellinia bunodes, respectively. In Puerto Rico, there are two additional leaf spot diseases of little importance caused by Cercospora instabilis and Vellosiella cajani.

108. COSTA, A.S., FRANCO DO AMARAL, J., VIEGAS, A.P., SILVA, D.M., TEIXEIRA, C.G., and PINHEIRO, E.D. 1957. Bacterial halo blight of coffee in Brazil. Phytopathologische Zeitschrift 28:427-444.

The Pseudomonas sp responsible gave a positive reaction when inoculated into pigeonpeas, among other plants.

109. CURZI, M. 1932. [Of African fungi and diseases. I. Concerning certain parasitic Hyphomycetes from Italian Somaliland] (In It.) Bollettino della R. Stazione di Patologia Vegetale di Roma ns 12:149-168.

A new fungal parasite, Cercodeuterospora trichophila, was reported on the leaves of pigeonpea from Somaliland.

110. DAHIYA, B.S. 1980. An annotated bibliography of pigeonpea 1900-1977. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. 183 pp.

The pathology section (pages 110-141) contains 293 abstracts on fungal, bacterial, virus, and nematode diseases.

111. DAKE, G.N. 1974. Studies on Fusarium oxysporum f. udum (Butl.) Snyder and Hansen causing wilt of tur, Cajanus cajan (L.) Millsp. M.Sc. thesis, Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India.

112. DALE, W.T. 1943. Preliminary studies of the plant viruses of Trinidad. Tropical Agriculture 20:228-235.

Pigeonpea seedlings were infected with cowpea mosaic in a greenhouse.

113. DALE, W.T. 1949. Observations on a virus disease of cowpea in Trinidad. Annals of Applied Biology 36:327-333.

Symptoms of cowpea mosaic on pigeonpea are described. Ceratoma ruficornis is an efficient vector.

114. DASH, J.S. 1917. Crop diseases. Report of the Department of Agriculture, Barbados, 1915-16. pp. 37-38.

A species of Colletotrichum was found on pigeonpea at Codrington, Barbados, which appeared to cause death of branches.

115. DASTUR, J.F. 1946. Report of the Imperial Mycologist. Scientific Reports of

the Indian Agricultural Research Institute, 1944-45. pp. 66-72.

Of 28 pigeonpea varieties tested for their reactions to F. udum, IP-80 was immune, IP-41 and Hybrid 5 (D 419-2-4) showed up to 5% infection, and the rest were highly susceptible to the wilt. In an infested field plot IP-80 developed 4% infection, C-15, A 126-4-1, and Thadgam 1-4-7 up to 7% IP-41 up to 12%, and three others were highly susceptible.

116. DEIGHTON, F.C. 1929. Report of the Mycological Section. Report, Lands and Forests Department, Sierra Leone, 1928. pp. 14-19.

A rust (Uredo cajani) was found to be common on the older leaves at Njala.

117. DEIGHTON, F.C. 1932. Mycological work. Report, Agricultural Department, Sierra Leone, 1931. pp. 20-25.

A strain of Rhizoctonia solani with large sclerotia was found on maize and pigeonpea.

118. DEODIKAR, G.B., and THAKAR, C.V. 1956. Cyto-taxonomic evidence for the affinity between Cajanus indicus Spreng, and certain erect species of Atylosia W. and A. Proceedings of the Indian Academy of Sciences, Section B 43:37-45.

Atylosia spp may be useful as a forage legume and also in breeding varieties of pigeonpea combining hardiness, perennial habit, tolerance of drought, and resistance to pests and diseases. A. lineata and A. sericea have shown a high degree of resistance to pod borer (Exelastis atomosa) and F. udum.

119. DESAI, B.G., PATEL, J.C., and VORA, M.S. 1981. Bracteomania: a genetic abnormality giving a virus disease syndrome in pigeonpea. International Pigeonpea Newsletter 1:20-21.

120. DESHPANDE, R.B., JESWANI, L.M., and JOSHI, A.B. 1963. Breeding of wilt resistant varieties of pigeonpea. Indian Journal of Genetics and Plant Breeding 23:58-63.

Field performance tests conducted at different locations in different states indicated that NP(WR)-15, apart from maintaining a high degree of wilt resistance, has given higher yields than the controls in most experiments. Exceptions occurred in places located in central and southern India where early types are required because of the short growth period.

121. DEY, P.K. 1947. Plant pathology. Report, Department of Agriculture, Uttar Pradesh, 1944-45. pp. 38-40.

Incidence of pigeonpea wilt (F. udum) was reduced from 64 to 38% in a susceptible variety when intercropped with sorghum.

122. DEY, P.K. 1948. Plant pathology. Report, Department of Agriculture, Uttar Pradesh, 1946-47. pp. 39-42.

By growing pigeonpea with sorghum in an artificially infected soil, incidence of F. udum wilt was reduced for a second season. Variety NP-80 proved the most resistant (only 2.3% infection) of the varieties tested.

123. DOIDGE, E.M. 1941. South African rust fungi. 4. Bothalia 4:229-236.

Uromyces dolicholi was recorded on pigeonpea leaves.

124. DWIVEDI, R.P., and SAKSENA, H.K. 1975. Web blight disease of arhar (Cajanus cajan [L.] Millsp.) caused by Thanatephorus cucumeris. Indian Journal of Farm Sciences 3:113-114.

Disease surveys showed a prevalence of this disease in several improved pigeonpea varieties such as Prabhat, T-21, and T-17. Repeated isolations from diseased leaf tissue yielded cultures of the imperfect fungus Rhizoctonia solani Kuhn. The web blight disease of pigeonpea has not been studied so far. Its symptoms are different from those of R. solani and R. bataticola.

125. DWIVEDI, R.S., and TANDON, R.N. 1976. Studies on some aspects of seed mycoflora of pigeonpea. Proceedings of the Indian Science Congress 63:63-64.

Fusarium udum was reported seed-borne.

126. EDWARD, J.C. 1954. Macrophomina and Botryodiplodia, two distinct genera of Sphaeropsidaceae. Allahabad Farmer 28:5.

Cultural and infection studies are reported. Data are given on M. phaseoli from pigeonpea.

127. EDWARD, J.C., and MISHRA, S.L. 1968. Heterodera vigni n. sp. and second stage larvae of Heterodera spp. in Uttar Pradesh, India. Allahabad Farmer 43:155-159.

During routine examination of farmed soils and rhizospheres, Heterodera spp were found on the roots of pigeonpea. The cysts were found to belong to a new species, named H. vigni; the morphology of its females, males, second-stage larvae, cysts, and eggs is described.

128. EDWARD, J.C., SINGH, K.P., TRIPATHI, S.C., SINHA, M.L., and RANADE, K. 1977. Rhizosphere mycoflora and nematodes fauna of some field crops and vegetables in Allahabad, India. Allahabad Farmer 48:131-151.

Higher numbers of fungi were found associated with legumes than with nonlegumes, irrespective of season. Although pigeonpea (cv T-21) is a legume, noticeably fewer fungi were recorded on it than on other legumes, probably because it is grown under rainfed conditions. The observations showed that the presence of moisture and adequate amounts of nutrients in the soil could influence favorably the multiplication of fungi. The population densities of rhizosphere fungi in the roots and in the soils around pigeonpea were 145 and 454/g of dry soil, respectively. The population of nematodes was 440 in 100 ml soil.

129. EDWARD, J.C., and SINGH, K.P. 1979. Interaction between Heterodera cajani and Fusarium udum on pigeonpea. Allahabad Farmer 50:23-24.

The damage caused by Heterodera cajani with F. udum on pigeonpea variety Type-21, under greenhouse conditions, is described. Fifty cysts of H. cajani + F. udum per pot increased final cyst population (1009), decreased root length (9.0 cm) and shoot length (26.0 cm) as compared with the control (without cysts), final cyst population (nil), root length (11.4 cm), and shoot length (44.4 cm).

130. ELLIS, M.A., FOOR, S.R., and MELENDEZ, P.L. 1976. Effect of internally seed-borne fungi on germination of pigeonpea in Puerto Rico. Memoria de la Sociedad Puertorriquena de Ciencias Agricolas 2:8-9. (Abstract.)

Several fungi were isolated from surface-sterilized seeds of pigeonpea variety 2B-Bushy grown at Isabela, Puerto Rico. These included species in the following genera: *Alternaria*, *Cladosporium*, *Fusarium*, *Penicillium*, and *Phomopsis*. *Phomopsis* was consistently isolated from nongerminated seeds. Treatment of seed with thiram reduced the recovery of fungi and increased in vitro germination.

131. (Deleted.)

132. ELLIS, M.A., HEPPERLY, P.R., FOOR, S.R., and PASCHAL , E.H., II. 1977. Seed treatment of pigeonpea with fungicides, antibiotics and certain solvents under tropical conditions. Fungicide and Nematicide Tests 32:177-178.

Pigeonpea seeds were treated with three fungicides -- captan, benomyl, and thiram -- for the recovery of internally seed-borne fungi, seed germination, and field emergence. Seed treatment with captan reduced the incidence of internally seed-borne fungi (12%), increased germination (88%), and field emergence (64%) as compared with the control: recovery of the fungi (77%), germination (62%), and field emergence (41%). Captan was found superior over thiram and benomyl.

133. ELLIS, M.A., and PASCHAL, E.H., II. 1977. Methods of controlling internally seed-borne fungi of pigeonpea (*Cajanus cajan*). Proceedings of the American Phytopathological Society 4:176. (Abstract.)

Pigeonpea seeds harvested at maturity reduced infection of seed by *Phomopsis* sp., *Fusarium semitectum*, and *Lasiodiplodia theobromae*. Incidence of internally seed-borne fungi was inversely correlated with in vitro germination and emergence in the field. Applications of benomyl to pigeonpea foliage through the growing season significantly reduced seed infection by fungi. Pigeonpea seed produced in arid regions of Puerto Rico had less seed infection by fungi and greater emergence than seed produced in regions of the island receiving greater rainfall.

134. ELLIS, M.A., PASCHAL, E.H., II, and POWELL, P. 1977. The effect of maturity and foliar fungicides on pigeonpea seed quality. Plant Disease Reporter 61:1006-1009.

Several genera of internally seed-borne fungi were isolated from pigeonpea cv 2B-Bushy, produced in Puerto Rico. Recovery of *Phomopsis* sp, *Fusarium semitectum*, *Lasiodiplodia theobromae*, and other internally seed-borne fungi was inversely correlated with in vitro germination and field emergence. *Alternaria tenuissima* appeared to have no effect on seed germination. Pod infection by all fungi occurred while the pods were immature and green in color. Infection of the seeds did not occur until after the seeds matured and changed color from green to white. Seed infection by fungi increased with time in the field past maturity. Because pods ripen over a long period of time, harvesting of many mature pods was delayed by as much as 3 weeks before the crop reached maturity (95% of the pods mature). Seeds from field-grown plants sprayed with benomyl (2.2 kg/ha) either twice or four times, 1 week apart, had significantly fewer internally seed-borne fungi, except A. tenuissima, and significantly greater in vitro germination and field emergence than seeds from nonsprayed plants. Seeds from pods that were harvested at 5-day intervals, as they matured, had a significantly lower incidence of internally seed-borne fungi and higher in vitro germination than seeds from plants that received two applications of benomyl or the nontreated control.

135. ELLIS, M.A., PASCHAL, E.H., II, and ROSARIO, E. 1977. Similarities in the internally seed-borne fungi of four leguminous crops. Proceedings of the American Phytopathological Society 4:176. (Abstract.)

Seeds of bean, cowpea, pigeonpea, and soybean produced at Isabela, Puerto Rico, were infected by Alternaria tenuissima, F. semitectum, Lasiodiplodia thoebromae, and Phomopsis sp. The percentage seed infection by these fungi increased with time in the field past maturity for all crops. Foliar application of benomyl significantly reduced seed infection of all fungi, except A. tenuissima, and increased seed quality.

136. ELLIS, M.A., PASCHAL, E.H., II, RAVALO, E.J., and ROSARIO, E. 1978. Effect of growing location on internally seed-borne fungi, seed germination, and field emergence of pigeonpea in Puerto Rico. Journal of Agriculture of the University of Puerto Rico 62:355-360.

Ten genera of fungi were isolated from the internal tissue of four pigeonpea cultivars grown at Isabela. The occurrence of total internal seed-borne fungi, Phomopsis sp, Lasiodiplodia (Botryodiplodia) theobromae, F. semitectum, and Alternaria tenuissima was negatively correlated with emergence in the field. The occurrence of Aspergillus sp was not negatively correlated with field emergence.

137. ELLIS, M.A., and SMITH, R.S. 1978. Effect of incubation temperature on recovery of internally seed-borne fungi and germination of pigeonpea seeds. Tropical Grain Legume Bulletin 13-14:22-25.

Internally seed-borne fungi are associated with reduced germination of pigeonpea seed. As the percentage incidence of seed-borne fungi increased, the percentage germination in vitro decreased for all cultivars tested. All fungal species recovered from seeds were negatively correlated with in vitro germination. Incubation temperature had a marked effect on the recovery of fungi from seeds and seed germination in vitro. By changing incubation temperature from 25 to 35 °C, the apparent health of all seed lots tested was significantly improved as expressed by in vitro germination. When seed lots incubated for 7 days at 25 °C were observed, a high percentage of seeds had not germinated (apparently dead) and were covered by fungal mycelium. With incubation at 35 °C, the same seed lot had a significantly lower percentage incidence of seeds showing fungal growth and significantly higher in vitro germination. The germination potential, i.e., the actual number of viable seeds of each seed lot, was more accurately recorded at 35 °C than at 25 °C, and the number of seeds infected by fungi was more accurately recorded at 25 °C than at 35 °C.

138. ELLIS, M.A., MINOR, H.C., ABRAMS, R., and JULIA, F.J. 1979. Effect of delayed harvest and fungicide sprays on pigeonpea seed quality in Puerto Rico. Journal of Agriculture of the University of Puerto Rico 63:428-435.

Seeds were harvested at maturity and 1, 2 or 3 weeks later from unsprayed plants or plants sprayed with maneb or benomyl (or both) at 1-week invervals beginning 110 days after planting. At each harvest date, the decrease in germination and emergence and the increase in seed-borne fungi were significantly less for seeds from benomyl-sprayed plants than from those unsprayed or sprayed with maneb. Seed germination in vitro and field emergence decreased and the internally seed-borne fungi increased with each delay in harvest for all treatments. There were no significant differences in total internally seed-borne fungi, germination in vitro or field emergence between maneb-sprayed and untreated plants. When harvested at maturity, plants from all treatments produced good-quality seed (>85% germination).

139. ELLIS, M.A., and PASCHAL, E.H., II. 1979. Effect of fungicide seed treatment on internally seed-borne fungi, germination and field emergence of pigeonpea (*Cajanus cajan*). Seed Science and Technology 7:75-81.

Internally seed-borne fungi representing seven genera were isolated from seeds of two pigeonpea cultivars. All fungi were located in the seed coat (testa) tissues and only occasionally were found in embryo tissues. Captan and thiram (protectant fungicides) moved into seed coat tissues but did not penetrate the embryo. Benomyl (systemic fungicide) penetrated the seed coat and embryo: thus, all fungicides were effective against fungi in the seed coat. Seeds treated with these fungicides had a significantly lower percentage recovery of total fungi in vitro and significantly higher in vitro germination and field emergence than nontreated (control) seeds.

140. ELLIS, M.A., RAVALO, E.J., and SMITH, R.S. 1979. Methods for pigeonpea seed storage in Puerto Rico. Journal of Agriculture of the University of Puerto Rico 63:423-427.

Seed moisture content and storage temperature are critical factors in the long-term storage of pigeonpea seed in Puerto Rico. Germination of seed maintained at ambient temperature remained high (90%) after 1 year when seed moisture content ranged from 9 to 13%, but not 17%, and seeds were stored in airtight containers. Germination remained high at all moisture levels when seeds were stored in airtight containers or in cloth bags in cold storage (13 °C). In this study, in which high-quality seed was used (germination >90%), the percentage of seed-borne fungi significantly decreased from 15 to 2% or less after 12 months in storage. *Bacillis subtilis* was associated with all dead seeds.

141. ELLIS, M.A., SMITH, R.S., and SAMBRANO, O. 1979. Effect of fungicide seed treatment on field emergence of poor and good quality pigeonpea (*Cajanus cajan*). Journal of Agriculture of the University of Puerto Rico 63:8-12.

Poor-quality and good-quality seed lots of cv 2B-Bushy were treated with fungicides. All treatments significantly increased field emergence of the poor-quality seed. There was no significant effect on the good-quality seed. When surface-disinfected poor-quality seeds were treated with thiram and placed on potato dextrose agar, germination increased and the incidence of internally seed-borne fungi decreased.

142. FELIX, S. 1960. A list of *Cercospora* occurring in Mauritius with short notes on the newly recorded species of some economic importance. Revue Agricole et Sucriere de l'Ile Maurice 9-14.

Cercospora cajani is included as a new species.

143. FENNELL, M.A. 1963. Present status of research on edible legumes in Western Nigeria. Proceedings of the Nigerian Grain Legume Conference 1:16-29.

Progress in the evaluation of local and introduced varieties of several legumes, including pigeonpea, is reported. Hope 5989 is a variety of pigeonpea from United Sates with tolerance of *Meloidogyne*.

144. GADEWAR, A.V., and RAUT, N.K. 1976. Translocation of Benlate in germinating seeds and seedlings of *Cajanus cajan*. Indian Journal of Mycology and Plant Pathology 6:108-109.

Benlate was found to be translocable when applied as a seed dresser. It was also absorbed by the roots and translocated into the leaves of 1-month-old seedlings.

145. GAIKWAD, B.M., and KOTE, S.S. 1981. Bacterial leaf spot and stem canker of pigeonpea (*Cajanus cajan*) caused by *Xanthomonas cajani*. Indian Journal of Mycology and Plant Pathology 11:50-56.

During the year 1977 the incidence of bacterial leaf spot and stem canker disease of pigeonpea at Parbhani was found to be up to 40%, and diseased plants yielded 10-15% affected grains. Host range studies revealed that the pathogen could infect only pigeonpea out of 14 different hosts inoculated, and the pathogen could infect leaves and stems of pigeonpea plants up to the age of 135 days and 145 days, respectively. The varieties C-49, C-60, C-69, E-200, JA-8, Pant A-2, and E-175 showed a high degree of resistance. In in vitro studies streptocycline (100 ppm), Agrimycin (150 ppm) and Agallol (200 ppm) inhibited 100% growth of the pathogen. On the basis of cultural, morphological, physiological, and host range studies the pathogen under study was identified as *X. cajani* Kulkarni et al. 1953.

146. (Deleted.)

147. GHOSH, M.K. 1975. Control of *Fusarium* wilt of pigeonpea by various treatments. M.Sc. thesis, Bidhan Chandra Krishi Vishwa Vidyalaya, Kalyani, West Bengal, India.

148. GHOSH, M.K., and SINHA, A.K. 1981. Laboratory evaluation of some systemic fungicides against *Fusarium* wilt of pigeonpea. Pesticides 15:24-27.

Spore germination of *F. udum* was completely inhibited by Benlate and Campogran-M at 50 ppm, while mycelial growth was prevented by Bavistin at 25 ppm and BAS 38601F at 50 ppm. The most effective seed treatment proved to be BAS 38601F, followed by Bavistin and Benlate.

149. GHOSH, P., and MUKHERJEE, S. 1969. Preliminary note on the study of microflora from the rhizosphere of *Cajanus cajan* Millsp. Proceedings of the Indian Science Congress 56:317-318. (Abstract.)

Microflora, especially the fungus flora from the different rhizospheres of pigeonpea, were studied. The soil samples were collected every 5 cm along and around the length of the tap root of the host plant and designated as a, b, and c, from above downwards and a', a", b', b", c', c", along corresponding horizontal levels. The frequency of distribution of the growing colonies with 0.01 dilution was found to be 4 at c-level, 3 at c'-level and 2 at c"-level, indicating that fungus flora decreased away from the root region proper. The distribution of the colonies was, however, maximum at b-level of the soil. Many of the fungi recorded are also abundant in the phyllosphere, and are conspicuously saprophytic.

150. GODBOLE, G.M., DAKE, G.N., and MAYEE, C.D. 1977. Quantitative estimation of pigeonpea stem canker intensity. Research Bulletin of the Marathwada Agricultural University 1:135-136.

A suitable technique for scoring infection grades was developed. Different infection grades formulated to record the diseases are given. Varieties such as BDN-1, BDN-2, and C-11 showed moderate reaction, while Prabhat and Kaki exhibited a high degree of susceptibility to Colletotrichum capsici.

151. GODFREY, G.H. 1928. Legumes as rotation and trap crops for pineapple fields. Bulletin, Hawaiian Pineapple Canners' Association Experiment Station no.10. 21 pp.

In Hawaii, pigeonpeas proved to be one of the leguminuous crops that exhibited high levels of resistance to root-knot nematode (Heterodera radicicola) in trials planted on pineapple land heavily infested with nematode. Pigeonpeas appeared to be free of most diseases and pests. The pigeonpea cultivar New Era exhibited high levels of resistance to root-knot nematode. In Oahu pigeonpea plantings, a few plants were found showing a root-rot condition that was accompanied by a white-mold growth. Plants in two pigeonpea varieties in an experimental planting on Oahu exhibited typical crown gall symptoms similar to those caused by Bacterium (= Agrobacterium) tumefaciens.

152. GONZAGA, E., and LORDELLO, L. 1960. Intereferences of nematodes in agricultural practices. Rural Review Society of Rural Brasil 40:12-13.

In Brazil, in a rotation of rice and pigeonpea, the pigeonpea crop showed an inferior stand in its consecutive 2nd year while the plants in plots where rice and pigeonpea were sown alternately were healthy. This was due to a heavy infestation with two nematodes which proliferate when pigeonpea is cultivated and are thwarted in their development by rice.

153. GOODLING, H.J. 1962. The agronomic aspects of pigeonpeas. Field Crop Abstracts 15:1-5.

In the West Indies, a usually fatal disease of perennial crops was collar- and stem-canker due to Physalospora cajanae. Primarily, small gray, scutiform lesions with dark edges develop on the stems and branches; later the affected parts become girdled and die. Although canker diseases have also been ascribed to Diplodia cajani and Phoma sp, pathogenicity has been associated with P. cajanae.

154. GOVINDASWAMY, C.V. 1951. Some studies on the effect of associated soil

microflora on Fusarium udum Butl., the wilt organism of pigeonpea (Cajanus cajan [L.] Millsp.), with special reference to its pathogenicity. Thesis, Indian Agricultural Research Institute, New Delhi, India.

155. GUNASEKARAN, C.R., MUTHUKRISHNAN, T.S., and RAJENDRAN, G. 1976. Evaluation of chemicals for controlling pigeonpea cyst nematode Heterodera cajani in red gram. Madras Agricultural Journal 63:382-383.

The total absence of cyst formation of H. cajani on the roots of the treated plants indicate the possible control of the nematode with the two chemicals, fensulfothion and carbofuran.

156. GUPTA, P., and EDWARD, J.C. 1974. Some economically important new hosts of Heterodera vigni in Uttar Pradesh, India. Plant Disease Reporter 58:345-347.

Pigeonpea was shown to be a host.

157. GUPTA, S.C., and SINHA, S. 1951. Further additions to the Synchytria of India. Indian Phytopathology 4:7-10.

Near Agra Synchytrium phaseoli-radiata was observed on urd (Vigna mungo) and pigeonpea.

158. GUPTA, S.C., REDDY, M.V., and NENE, Y.L. 1981. Sterility-mosaic resistant lines of early-maturing pigeonpea developed at ICRISAT. International Pigeonpea Newsletter 1:20.

During the rainy season 116 pigeonpea progenies with at least one parent resistant to pigeonpea sterility mosaic virus were screened in the nursery. Fifteen resistant lines (listed) with promising yield were identified.

159. GUPTA, S.L. 1954. Kanpur Agricultural College Journal 13:18-25.

Considerable control of the wilt disease in pigeonpea was achieved by adopting mixed cropping with sorghum.

160. GUPTA, S.L. 19[illegible]. The effect of mixed cropping of arhar (Cajanus indicus Spreng.) with jowar (Sorghum vulgare Pers.) on incidence of arhar wilt. Agriculture and Animal Husbandry in Uttar Pradesh 3(10-12):31-35.

161. HAIDER, M.G., SINGH, R.K., PRASAD, H., NATH, R.P., and SHARMA, R.N. 1978. Effect of some common fungicides on the incidence of pigeonpea wilt. Indian Phytopathology 31:511-512.

In field trials with crops grown in soil naturally infested with F. udum the best control over 3 yr was given by captan followed by Brassicol (quintozene), phenylmercury acetate, sawdust and copper oxychloride.

162. HAIGH, J.C. 1930. Macrophomina phaseoli (Maubl.) Ashby and Rhizoctonia bataticola (Taub.) Butler. Annals of the Royal Botanical Gardens of Peradeniya 11:213-249.

Twenty-seven strains of M. phaseoli (R. bataticola) have been divided by the author into three groups, according to their mean sclerotia diameter in culture. The first, or C, group contains those strains having a mean sclerotial diameter of 120 μ or less, the middle, or B, group those with one of about 200 μ, while the A group comprises those whose sclerotia are conveniently measured in millimeters. Sclerotia belonging to any of these groups may be isolated from trees and woody plants generally (all three were obtained from rubber and coconut), but herbaceaous plants as a rule give sclerotia only of group C, and pycnidia of M. phaseoli were obtained only from these hosts. Pycnidia were obtained in cultures of a C strain from pigeonpea grown on sterilized pigeonpea stems. The pycnospores were typical of M. phaseoli, measuring 16-27 by 5-11 μ and averaging 24 by 8 μ, though some pycnidia were found in which the spores were shorter and broader than normal. Cultured on maize meal agar, the pycnospores produced a growth in which both pycnidia and sclerotia were present. Three of the pycnospore cultures were put back onto pigoenpea twigs, whereupon two produced sclerotia only, while the third produced a distinctive growth with scanty white mycelium, no sclerotia, and abundant black, solitary, shining, pycnidia with many spores. In culture these gave pycnidia only, whereas pycnospores from the twigs inoculated with the other two cultures produced a sclerotial form similar to that used for the original inoculations.

163. HAMMERTON, J.L. 1973. A yellowing and dieback syndrome of pigeonpea, Cajanus cajan (L.) Millsp. Proceedings of the Caribbean Food Crops Society Meeting 11:197-208.

The presence is reported of the following nematodes associated with chlorosis and dieback of pigeonpea in Jamaica: Rotylenchulus reniformis, Tylenchorhynchus sp, Helicotylenchus sp, Pratylenchus sp, Scutellonema sp, Longidorus sp, and Hoplolaimus sp. R. reniformis was the most abundant nematode in soil samples. Pathogenicity was not proven.

164. HAMMERTON, J.L. 1975. Effects of growth regulators on pigeonpea (Cajanus cajan). Experimental Agriculture 11:241-245.

In trials in Jamaica with dwarf semideterminate pigeonpea cvs 17 (BF) and 20 (GL 27/4a), ethephon at 250 ppm and 500 ppm substantially increased pod numbers in the rust (Uredo cajani) susceptible cv 20 by inducing leaf fall and a second flowering, but had no such effect on the rust-resistant cv 17. In both cvs ethephon reduced seed number per pod. Of nine other growth-regulators tested, B-9 at 2300 ppm increased pod numbers in cv 17 but reduced mean pod weight and seed number per pod; the others gave no significant results over the control.

165. HANDIQUE, L.K. 1951. Report of the Department of Agriculture, Assam, 1949-50. Pt.1. 357 pp.

Many cultivars of pigeonpea introduced from nearby states for inclusion in the breeding program proved susceptible to Fusarium wilt. For some 100 promising selections several true-breeding pure lines were isolated; these combined desirable yield capacity and quality with wilt resistance.

166. HANSFORD, C.G. 1938. Annual report of the Plant Pathologist 1936. Report of the Department of Agriculture, Uganda, 1936-37. Pt.2. pp. 43-49.

Various Fusarium spp, including forms belonging to Hypomyces ipomoeae and Lisea and Gibberella, were isolated from pigeonpea plants that had died from the top downwards. The Gibberella spp appeared to be the primary parasites.

It is a different disease from the wilt in India caused by F. vasinfectum.

167. HANSFORD, C.G. 1943. Contributions towards the fungus flora of Uganda. 5. Fungi imperfecti. Proceedings of the Linnean Society of London, 1942-43. pp. 34-67.

Dendrochium gigasporum was isolated from dying pigeonpea stems.

168. HAQUE, S.Q. 1979. Status of virus diseases of grain legumes in the Commonwealth Caribbean. Presented at the Regional Workshop on Tropical Grain Legumes, University of West Indies, St. Augustine, Trinidad, Trinidad and Tobago. pp. 7-8. (Abstract.)

The only virus disease recorded on pigeonpea in the Commonwealth Caribbean is cowpea mosaic virus (CPMV) in Trinidad. The writer has observed only occasional incidence of mosaic symptoms on pigeonpea in Trinidad. Pigeonpea is not a preferred host of the beetle-vector of CPMV, and this may account for the low incidence of the disease.

169. HARINATH NAIDU, P., and NIRULA, K.K. 1979. Quarantine important diseases of sorghum, pearl millet, chickpea, pigeonpea and groundnut. Indian Journal of Plant Protection 7:175-188.

Quarantine measures in India for important diseases of sorghum, pearl millet, chickpea, pigeonpea, and groundnut are described. In the case of pigeonpea, anthracnose, bacterial leaf spot and stem canker, sterility mosaic virus, and yellow mosaic virus do occur in the country, but they are nevertheless subject to quarantine restrictions.

170. HASAN, A., KHAN, M.W., RASHID, A., and ABRAR, M.K. 1975. Relative efficiency of certain fungicides against Colletotrichum spp. Indian Journal of Mycology and Plant Pathology 5:41. (Abstract.)

Fungicides Brassicol, thiram, Coprantol, Dithane Z-78, Dithane M-45, Agrosan GN, and captan, as well as DDT, successfully inhibited the growth and sporulation of C. truncatum (pigoenpea isolate). The best performance was exhibited by Coprantol where the pathogen failed to grow at any of the concentrations tried (0.1, 0.2 and 0.3%). It was followed by Brassicol. Captan and Agrosan GN were effective at higher concentrations (0.3%).

171. HASAN, A., and KHAN, A.M. 1979. Varietal screening for anthracnose disease of arhar. Acta Botanica Indica 7:126-128.

When 49 pigeonpea cultivars were screened against C. truncatum some proved highly susceptible, some were resistant, and a few (NPWR-15, Pant A-9, Prabhat, R-98, and 1234) were immune. When planted late (September-October) a few of the susceptible cultivars escaped severe disease incidence.

172. HASAN, A., and KHAN, A.M. 1979. On the fungicidal control of anthracnose disease of arhar. Indian Journal of Mycology and Plant Pathology 9:156-159.

Out of nine fungicides tested copper oxychloride, carboxin, benomyl, captan, mancozeb, and thiram were found to be highly inhibitory to spore germination and vegetative growth of C. truncatum. These fungicides were more effective under field than glasshouse conditions. A preinoculation prophylactic spray gave better control than a postinoculation spray. All the fungicides had a marked fungistatic effect on germ-tube and colony characters of the fungus.

173. HIREMATH, R.V., BALASUBRAMANYAM, R.H., and PURANIK, S.B. 1973. Effect of culture filtrate of *Fusarium udum* Butler on the rhizosphere microflora of *Cajanus cajan* (L.) Millsp. Indian Journal of Microbiology 12:229-230.

F. udum has been shown to produce three enzymes, viz pectin methyl esterase, polygalacturonase, and cellulase in vivo and in vitro. The culture filtrate was added to the base of 25-day-old pigeonpea seedlings grown in pots. Fungal, actionomycete, and bacterial populations of the rhizosphere soil were significantly higher than those of the nonrhizosphere soil. The plants treated with culture filtrate did not show any variation in the fungal population. There was a significant increase in the bacterial population in the rhizosphere of treated plants within 24 h after treatment.

174. HIRUMI, H., MARAMOROSCH, K., and HICHEZ, E. 1973. Rhabdovirus and mycoplasma-like organism: natural dual infection of *Cajanus cajan*. Phytopathology 63:202. (Abstract.)

Pigeonpea plants with a proliferation disease, having parts of the foliage pale green and also showing witches' broom symptoms, were collected. Electron micrographs showed mycoplasma-like organisms (MLOs) as well as bullet-shaped virus particles in the phloem. This appears to be the first report of natural dual infection by rhabdovirus and MLOs.

175. HUTTON, D.G., and HAMMERTON, J.L. 1975. Investigating the role of *Rotylenchulus reniformis* in a decline of pigeonpea. Nematropica 5:24.

There was no relationship among numbers of *R. reniformis* in the soil around plants of three pigeonpea cultivars at Lawrencefield, Jamaica, and the number of plants exhibiting symptoms of decline. Where populations of *R. reniformis* were suppressed, plants grew faster and flowered earlier.

176. IHFIS, T., FREVRE, R.H., and KENNARD, H.C. 1937. *Pellicularia filamentosa* on *Tephrosa* and *Cajanus indicus* in Puerto Rico. FAO Plant Protection Bulletin 5:159-160.

The disease can be controlled by using Bordeaux mixture and zineb.

177. INDIAN AGRICULTURAL RESEARCH INSTITUTE. 1931. Work on *Cajanus cajan* at Pusa. Scientific Reports of the Imperial Institute of Agricultural Research, Pusa, 1929-30.

The Imperial Economic Botanist reports on an attempt to obtain wilt-resistant strains of pigeonpea and on the study of the inheritance of various characters such as: flower, seed, and pod color; pod habit; growth habit; and immunity to wilt disease.

178. INDIAN AGRICULTURAL RESEARCH INSTITUTE. 1946. Scientific Reports of the Indian Agricultural Research Institute, 1945-46. 109 pp.

Work on pigeonpea wilt (*F. udum*) resistance was continued. Hybrid C-38-3-1, from the cross between IP-24 and IP-51, appeared to be completely immune to artificial infection in the field. IP-80 and IP-41 showed only 1% loss. The existence of duplicate genes governing the characters of the "Cawnpore" mutant was confirmed.

179. INDIAN AGRICULTURAL RESEARCH INSTITUTE. 1947. Scientific Reports of the Indian Agricultural Research Institute, 1946-47. 131 pp.

The F3 of a cross between NP-69 and Cawnpore-132 was selected for early maturity, Fusarium wilt resistance, and bold-seededness. NP types and other material were tested for wilt resistance.

180. INDIAN AGRICULTURAL RESEARCH INSTITUTE. 1948. Scientific Reports of the Indian Agricultural Research Institute, 1947-48. 182 pp.

Cultures of the pigeonpea were further selected on the basis of resistance to wilt (F. udum), maturity, and other characters. Some of the material derived from the crosses between NP-69 and NP-132 showed no wilt infection. In the Burma collection, New Era 40-6 was free from wilt disease, as in the previous year.

181. (Deleted.)

182. INDIAN AGRICULTURAL RESEARCH INSTITUTE. 1953. Scientific Reports of the Indian Agricultural Research Institute, 1950-51. 120 pp.

Out of eight wilt-resistant pigeonpea varieties and five hybrid derivatives, D-16-17-2 gave the highest yield. The varieties NP-41, C-38-1-2, and D-419-2-4 were highly resistant to F. udum.

183. INDIAN AGRICULTURAL RESEARCH INSTITUTE. 1954. Scientific Reports of the Indian Agricultural Research Institute, 1952-53. 108 and 114 pp.

In pigeonpea wilt-resistant but, in most cases, late-maturity selections have been developed; crosses are to be made with an early-maturing Brazilian strain to combine earliness and wilt resistance.

184. INDIAN AGRICULTURAL RESEARCH INSTITUTE. 1956. Scientific Reports of the Indian Agricultural Research Institute, 1955-56. 142 pp.

Pigeonpea wilt incidence in 64 early high-yielding lines from NP-51 x UP-type 132, Brazil x NP-41, NP-51 x Jamaica 40-28B, and NP(WR)-15 x NP-51 ranged from 0.0 to 10.2%. Some lines yielded 30-100% more than the best control. Lines from Brazil x NP-41 and NP-51 x Jamaica 40-28B equalled EB-3 and EB-38 in earliness.

185. INDIAN AGRICULTURAL RESEARCH INSTITUTE. 1971. New vistas in pulse production. New Delhi, India: IARI. 109 pp.

The aspects discussed are: plant production, genetic improvement, agronomy of pulse crops, rhizobial inoculation, use of pulse crops in rotations, improvement of nutritional quality, plant protection, diseases, and insect pests.

186. INDIAN COUNCIL OF AGRICULTURAL RESEARCH. 1950. Annual report for 1948-49, New Delhi, India: ICAR. pp. 177-190.

Varietal tests for wilt resistance and experiments with Bacillus subtilis as an inhibitor of F. udum are summarized.

187. INGHAM, J.L. 1976. Induced isoflavonoids from fungus-infected stems of pigeonpea (Cajanus cajan). Zeitschrift fur Naturforschung C31:504-508.

From stems inoculated with Helminthosporium (Cochliobolus) carbonum four antifungal isoflavones (7-hydroxy-4'-methoxy-; 5, 7, 4'-trihydroxy-; 5, 7, 2', 4'-tetrahydroxy; 5, 2', 4'-trihydroxy-7-methoxy) and one isoflavonone (5,2'-dihydroxy-7, 4'-dimethoxy-) were isolated. The structure of the last (cajanol) was confirmed by synthesis from ferreirin. A sixth compound was provisionally identified as 5, 2'- dihydroxy-7, 4'-dimethoxy isoflavone.

188. INGRAM, E.G., and RODRIGUEZ-KABANA, R. 1977. Susceptibility of pigeonpea to plant parasitic nematodes. Proceedings of the American Phytopathological Society 4:177. (Abstract.)

When grown in the greenhouse in soils from a soybean and a cotton field, pigeonpea was found to be a good host of several ecto- and endoparasitic nematodes, including Helicotylenchus dihystera, Hoplolaimus galeatus, Pratylenchus brachyurus, P. scribneri, and Tylenchorhynchus claytoni. Although no galls were caused by the root-knot nematode, Meloidogyne incognita, this nematode may be able to reproduce themselves in pigeonpea roots.

189. INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1973. Grain Legume Improvement Program. In IITA report. Ibadan, Nigeria: IITA. 78 pp.

Of the seven pigeonpea lines tested, 3D-8111 (UC 5543-1), 3D-8127 (UC 1381-1), and 3D-8104 (UC 5103-1) are proposed for release. They are high-yielding, semidwarf (120-150 cm), of short duration (106-140 days), and resistant to most diseases in Ibadan.

190. INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1975. Pigeonpeas. Pages 83-85 _n Annual report, 1974. Ibadan, Nigeria: IITA.

Three high-yielding, early, semidwarf bush lines are described. CITA-1 was mass-selected from TUC-5543 and has yellow flowers and green pods. CITA-2, derived from TUC-5103, has dark maroon-blotched pods and good disease resistance. CITA-3, derived from TUC-1463-1, is erect, bearing red-veined flowers and maroon-blotched green pods.

191. ISLAM, N. 1970. Effects of various carbon and nitrogen sources on growth and sporulation of Fusarium udum. M.Sc. thesis, Bidhan Chandra Krishi Vishwa Vidyalaya, Kalyani, West Bengal, India. 39 pp.

192. JACKSON, P.E. 1976. Gungo peas (Cajanus cajan). Bulletin, Ministry of Agriculture and Fisheries, Jamaica, New Series 64:164-166.

Rust (Uredo cajani) is one of the diseases affecting determinate and indeterminate pigeonpea cultivars in Jamaica. Less rust was observed on pigeonpea cultivars grown under dry conditions. Pigeonpea variety No. 17 exhibited the highest level of resistance to rust, although it was a low-yielder.

193. JAIN, A.C. 1949. Effect of certain microorganisms on the activity of Fusarium udum Butler, the causal agent of pigeonpea (Cajanus cajan [Linn.] Millsp.) wilt. Thesis, Indian Agricultural Research Institute, New Delhi, India. 50 pp.

194. JANARTHANAN, R. 1972. Occurrence of the pigeonpea cyst nematode in Tamil Nadu. Indian Journal of Nematology 2:215.

The pigeonpea cyst nematode, H. cajani, was found present in Tamil Nadu and infested cowpeas. It may also pose a serious problem to the cultivation of pulses.

195. JANARTHANAN, R., NAVANEETHAN, G., SUBRAMANIAN, K.S., and SAMUEL, G.S. 1972. Some observations on the transmission of sterility mosaic of pigeonpea. Current Science 41:646-647.

Detailed studies were made on the mode of transmision of this disease. The viral nature of the disease was established by graft transmission. In other tests it was proved that even a single mite was sufficient to transmit the disease. Both nymphs and adult mites were equally efficient in transmitting the disease.

196. JANARTHANAN, R., NAVANEETHAN, G., SUBRAMANIAN, K.S., and SAMUEL, G.S. 1972. A method for assessment of eriophyid mites on pigeonpea leaves. Madras Agricultural Journal 59:437.

A method is described to estimate the exact number of mites harbored in pigeonpea leaves. The leaves are immersed in methanol, ethanol or acetone mixed with glycerol in the ratio of 10:1. After 3-4 h the leaves can be gently spread over a clean glass slide and examined in a stereomicroscope under proper illumination, when all the mites are clearly seen.

197. JANARTHANAN, R., SAMUEL, G.S., SUBRAMANIAN, K.S., NAVANEETHAN, G., and KANDASWAMY, T.K. 1973. A report on the survey of sterility mosaic disease incidence on red gram in Tamil Nadu. Madras Agricultural Journal 60:41-44.

From a survey made over 9142 ha in different parts of Tamil Nadu, it was observed that pigeonpea sterility mosaic was prevalent in almost all parts of the state. The percentage incidence of the disease suggests heavy crop losses of pigeonpea in Tamil Nadu.

198. JAYARAJ, S., and SESHADRI, A.R. 1967. Preference of the leaf hopper Empoasca kerri Pruthi (Homoptera: Jassidae) for pigeonpea (Cajanus cajan [L.] Millsp.) plants infected with sterility mosaic virus. Current Science 36:353-355.

The higher content of carbohydrate in the healthy pigeonpea plants over diseased ones in leaves of medium maturity is probably not attractive to E. kerri. The leaf hopper prefers the reduced C:N ratio found in diseased leaves. Detailed studies on the nutrition physiology of the leaf hopper, including enzymatic studies, are required for understanding of the problem.

199. JEHLE, R.A., and WOOD, J.I. 1926. Diseases of field and vegetable crops in the United States in 1925. Plant Disease Reporter 45 (suppl.):152.

Diseases reported from Puerto Rico on pigoenpea were leaf spot (*Cercospora instabilis*, *Phyllostica* sp, and *Mycovellosiella cajani*); anthracnose (*Colletotrichum cajani*); rust (*Uromyces dolicholi*); and damping-off (*Rhizoctonia ferruginea*).

200. JESWANI, M.D., PRASAD, N., and GEMAWAT, P.D. 1975. Morphological variability in *Fusarium lateritium* f. *cajani*. Indian Journal of Mycology and Plant pathology 5:4.

The pathogen is highly variable in cultural characters. Single-spore isolates from single strains have also been observed to vary among themselves with regard to growth pattern, segmentation, substrate reaction, and pigmentation. Different isolates have the capacity of secreting differing quantities of metabolic products.

201. JESWANI, M.D., and GEMAWAT, P.D. 1981. Seed-borne nature of wilt of arhar. Pages 162 *in* Abstracts of papers of the Third International Symposium of Plant Pathology, 14-18 Dec 1981, New Delhi, India. New Delhi, India: Indian Phytopathological Society.

Wilt of pigeonpea is a serious problem all over the pigeonpea-growing areas in India where cultivation of the crop was previously unknown. Occurrence of the disease in these areas raises doubt about the possibility of the pathogen being carried with the seed. Investigations were therefore undertaken to understand the possible role of seed and its infection in the case of *Fusarium* wilt of pigeonpea caused by *F. lateritium* f.sp. *cajani*. Seed samples collected from field and plants from different localities, and examined by the blotting-paper test method (following ISTA rules), revealed that all such seed samples were infected. However, the incidence of infection varied from 3 to 30% depending upon the variety and severity of infection. Some of the seeds collected from apparently healthy plants also yielded *Fusarium*.

202. JOHNSON, J. 1939. Studies on the nature of brown root rot of tobacco and other plants. Journal of Agricultural Research 58:843-863.

Symptoms, hosts affected, and characteristics of an unknown causal agent of brown root rot disease are described. Pigeonpeas are susceptible.

203. JOSHI, A.B. 1957. Genetics of resistance to diseases and pests. Indian Journal of Genetics and Plant Breeding 17:305-317.

The inheritance of wilt resistance in pigeonpea appeared to be controlled by a pair of dominant duplicate genes.

204. JOSHI, C.G., and WANGIKAR, P.D. 1977. Efficacy of fungicides against stem canker and die-back disease of *Cajanus cajan* caused by *Colletotrichum capsici*. Indian Phytopathology 30:148.

The spore-germination and poisoned-food techniques were used to evaluate the efficacy of fungicides. The concentrations used in the spore-germination studies were 10, 50, 100, 200, 500, 1000, and 2000 ppm. In both the experiments Cuman, Benlate, Ziride, and captan were highly effective in inhibiting spore germination and mycelial growth. Calixin was effective in checking conidial germination completely at 10-ppm concentration and showed

91% inhibition of mycelial growth. Dithane Z-78, Macuprax, Bavistin, and Dithane M-45 were effective in the poisoned-food experiment in checking mycelial growth, but failed to check the spore germination at the lowest concentration of 10 ppm. However, all these were effective at higher concentrations over the control treatment.

205. JOSHI, C.G., and WANGIKAR, P.D. 1978. Efficacy of fungicides against Colletotrichum capsici. Indian Phytopathology 31:222-223.

Nine fungicides were tested against the stem canker and dieback of pigeonpea caused by C. capsici. Of these Cuman, Calixin, Benlate, Ziride, and captan showed complete inhibition of the spore germination at 10 ppm, whereas Macuprax, Dithane Z-78, and Bavisin inhibited the spore germination completely at 200 ppm.

206. KAISER, S.A.K.M., and SEN GUPTA, P.K. 1969. Cross protection against wilt disease caused by Fusarium oxysporum f.sp. udum in pigeonpea. Indian Journal of Mycological Research 7:38-39.

Control of pigeonpea wilt caused by F. oxysporum f.sp. udum could be achieved to the extent of 77.50 to 81.25% by prior inoculation of the host with the nonpathogens F. oxysporum f.sp. ciceri and F. oxysporum f.sp. vasinfectum.

207. KAISER, S.A.K.M., and SEN GUPTA, P.K. 1975. Infection and pathological histology of pigeonpea (Cajanus cajan [L.] Millsp.) plants inoculated with pathogenic and nonpathogenic formae speciales of Fusarium oxysporum. Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz 82:485-492.

Inoculation studies revealed that F. oxysporum f.sp. udum (F. udum) was host-specific, whereas F. oxysporum f.sp. vasinfectum and F. oxysporum f.sp. ciceri induced initial wilt symptoms from which the seedlings gradually recovered. The pattern of distribution of hyphae in pigeonpea tissue was similar for the three fungi but more concentrated in the case of the pathogenic species, particulary in the vascular bundles where only F. udum produced conidia.

208. KAISER, S.A.K.M., and SEN GUPTA, P.K. 1976. Serological and electrophoretic studies of three formae speciales of Fusarium oxysporum. Transactions of the British Mycological Society 67:33-37.

Studies showed some precipitin lines and a few protein bands to be common to f.sp. udum, vasinfectum, and ciceri. Results suggested a close relationship between F. oxysporum f.sp. udum (F. udum) and F. oxypsorum f.sp. vasinfectum. The renaming of the pigeonpea wilt pathogen as F. oxysporum f.sp. udum is supported.

209. KAISER, S.A.K.M., and SEN GUPTA, P.K. 1977. Inhibition of wilt symptoms by Fusarium oxysporum f.sp. udum in pigeonpea (Cajanus cajan) induced by other formae speciales of Fusarium oxysporum. Phytopathologia Mediterranea 16:1-4.

Protection of pigeonpea against F. oxysporum f.sp. udum was obtained by preinoculation with either F. oxysporum f.sp. vasinfectum or F. oxysproum f.sp. ciceri before inoculation with the pigeonpea pathogen, and also by mixed inoculation with the pathogen and any of the other host-specialized pathogens. A better control of the disease was always obtained by preinoculation with species not pathogenic to pigeonpea as compared with mixed inoculations. Extracts of seedlings inoculated with F. oxysporum from other hosts showed antifungal properties on the conidial germination and mycelial growth of F. oxysporum f.sp. udum.

210. KAISER, S.A.K.M., and SEN GUPTA, P.K. 1978. Population of three formae speciales of Fusarium oxysporum in the rhizosphere of host and non-host plants. Indian Journal of Mycological Research 16:41-46.

The population density of F. oxysporum f.sp. ciceri, f.sp. udum and f.sp. vasinfectum in the rhizosphere of host and nonhost plants was studied. The data revealed that, although the population of all the three f.sp. of F. oxysporum increased more significantly in the rhizosphere of the host than of the nonhost plants, yet in case of F. oxysporum f.sp. ciceri there was a slight decrease in the rhizosphere of nonhost plants. The root exudates of the host and nonhost plants were found to have stimulatory effects on the growth and sporulation of F. oxysporum f.sp. udum and f.sp. vasinfectum, but, in case of F. oxysporum f.sp. ciceri, the root exudate of nonhost plants had no effect on the growth and a decreasing effect on the sporulation of the organism.

211. KAISER, S.A.K.M., and SEN GUPTA, P.K. 1979. Role of pectolytic enzymes in pathogenesis by different formae speciales of Fusarium oxysporum on pigeonpea. Indian Phytopathology 32:311-313.

Fusarium oxysporum f.sp. udum causes wilting of pigeonpea. When the seedlings of pigeonpea were inoculated with the pathogen, lower leaves started yellowing within 10 days, the leaves drooped and severe leaf shedding occurred by the 15th day, and complete wilting of the seedlings took place within 20 days. But other formae speciales of F. oxysporum, such as vasinfectum, the cotton wilt pathogen, and ciceri, the Bengal gram (Cicer arietinum) wilt pathogen, when inoculated into pigeonpea seedlings caused only yellowing and drooping of lower leaves, but no wilting occurred. F. oxysporum f.sp. udum is known to produce pectic enzymes in vitro and in vivo. Studies were undertaken on the possible production of pectolytic enzymes in the pigeonpea seedlings inoculated with pathogenic and nonpathogenic formae speciales of F. oxysporum, and the possible role of these enzymes in pathogenesis.

212. KAISER, W.J. 1976. Important diseases and pests of bean (Phaseolus vulgaris), lima bean (Phaseolus lunatus) and pigeonpea (Cajanus cajan) in Africa. African Journal of Plant Protection 1:97-102.

Information is limited on the diseases that affect pigeonpeas in Africa and seriously lacking on the adverse effects of infection on yields and quality. Potentially important diseases of this crop are wilt (F. udum), rust (Uredo cajani), powdery mildew (Leveillula taurica), and nematodes (Meloidogyne sp). Pigeonpeas are also attacked by diseases of foliage (Cercospora cajani, Mycovellosiella cajani, Cercoseptoria cajanicola, and Thanatephorus cucumeris), stem (Pythium sp), roots (Armillaria mellea, Rhizoctonia solani and M. phaseolina), and seeds (Nematospora coryli). In countries where pigeonpeas are an important food crop, particularly India, Puerto Rico, and Trinidad, varieties have been developed that have resistance to prevailing strains of rust, wilt, and powdery mildew. In India and various countries of

the Caribbean, pigeonpeas are affected, often seriously, by virus or virus-like diseases, some of which are transmitted by whiteflies (Bemisia tabaci) and mite (Aceria cajani). It is not known whether these diseases occur on pigeonpeas in Africa. Every effort should be made to exclude them from the African continent.

213. KAISER, W.J., and ROBERTSON, D.G. 1976. Notes on East African plant virus diseases. II. Alfalfa mosaic virus. East African Agricultural and Forestry Journal 42:47-54.

East African isolates of alfalfa mosaic virus from alfalfa and potato produced necrotic local lesions and/or mosaic and leaf deformation symptoms in pigeonpea cultivar T-21 in greenhouse inoculation trials.

214. KAISER, W.J., BOCK, K.R., GUTHRIE, E.J., and MEREDITH, G. 1978. Occurrence of tomato black ring virus in potato cultivar Anett in Kenya. Plant Disease Reporter 62:1088-1092.

In sap inoculation studies in Kenya, pigeonpea cultivar T-21 was infected systemically with an isolate of tomato black ring virus (TBRV) from Anett potato. The virus was transmitted in seed from TBRV-infected pigeonpea plants.

215. KAISER, W.J., and MELENDEZ, P.L. 1978. A Phytophthora stem canker disease of pigeonpea in Puerto Rico. Plant Disease Reporter 62:240-242.

A new stem canker disease of pigeonpea caused by P. parasitica was observed at several locations in Puerto Rico. The pathogen induced necrotic, often depressed lesions on main-stem branches and petioles of pigeonpea plants. Isolates of P. parasitica from egg plants, pigeonpea, and tomato were pathogenic to pigeonpea stems.

216. KAISER, W.J. 1979. Natural infection of cowpea and mung bean by alfalfa mosaic virus in Iran. Plant Disease Reporter 63:414-418.

Iranian cowpea yellowing isolates of alfalfa mosaic virus induced yellow mosaic symptoms in pigeonpea in greenhouse inoculation tests.

217. KAISER, W.J. 1981. Diseases of chickpea, lentil, pigeonpea, and tepary bean in continental United States and Puerto Rico. Economic Botany 35:300-320.

A number of diseases of varying severity affect the roots, stems, petioles, leaves, pods, and seeds of the pigeonpea in tropical and subtropical areas of the United States, including Florida, Hawaii, Puerto Rico, and Texas. The diseases are caused primarily by fungi, although a few disorders of unknown etiology with virus or mycoplasma-like symptoms have been observed in Puerto Rico. Much of the pioneering research on pigeonpea diseases in the Western Hemisphere was done by researchers located at the Mayaguez and Rio Piedras experiment stations in Puerto Rico, beginning in the early 1900s. A majority of the early studies dealt with diseases caused by fungi, particularly those inciting diseases of the foliage, stems, and pods.

218. KALYANASUNDARAM, R. 1952. Ascorbic acid and Fusarium wilted plants. Proceedings of the Indian Academy of Sciences, Section B 36(3):102-104.

Studies in Madras on F. vasinfectum on cotton and F. udum on pigeonpea showed a reduction in ascorbic acid content of host leaves and an increase in reducing sugars. Reduction in chlorophyll and retardation of growth preceding wilting caused decreases in ascorbic acid content.

219. KAMAL, MALL, T.P., and SRIVASTAVA, R.P. 1975. Rhizosphere mycoflora of some virus infected cultivars of arhar (Cajanus cajan [L.] Millsp.). Technology 11:234-238.

The rhizosphere mycopopulation of different pigeonpea cultivars differed considerably. There were mycoorganic make-up differences in the roots of healthy and diseased plants. The rhizosphere effect was always greater in the healthy plants than in their diseased counterparts. The minimum rhizosphere effect was manifested by cultivar Prabhat infected with the severe strain of the virus. The results readily fit in with the physiological derangements of the plants. The degree of quantitative reduction in the rhizosphere mycoflora of diseased plants appeared to be directly correlated with the degree of the severity of infection in cultivar T-17.

220. KAMAL, MALL, T.P., and SRIVASTAVA, R.P. 1975. Microfungi at the root-soil interface of arhar (Cajanus cajan [L.] Millsp.) infected by pigeonpea sterility mosaic virus. Technology 11:434-436.

There was no difference in the total number of species associated with healthy and diseased rhizosphere. Certain fungi were confined to the rhizosphere either of the healthy or the diseased plants. Colony counts/g of dry soil were higher in the healthy plants than in the diseased ones. Several Penicillia and Aspergilli, particularly the members of Aspergillus ustus group, were characteristic of the rhizosphere under both diseased and healthy conditions. The rhizosphere effect was more prominent in case of healthy plants.

221. KAMAL, and VERMA, A.K. 1976. Microfungal flora in the root region of arhar (Cajanus cajan [L.] Millsp.). Fertilizer Technology 13:155-157.

Fungal population in rhizosphere-free soil, rhizosphere soil, and rhizoplane of pigeonpea have been studied. Thirty-nine species were isolated from nonrhizosphere, rhizosphere and rhizoplane regions. A total of 31, 23, and 22 fungal forms were isolated from nonrhizosphere, rhizosphere, and rhizoplane regions, respectively.

222. KAMAL, and VERMA, A.K. 1979. Seed-borne mycoflora of arhar (T-21), effect of culture filtrates of some isolates on seed germination and fungicidal treatment. Indian Journal of Mycology and Plant Pathology 9:41-45.

Seed mycoflora of pigeonpea variety T-21 were examined by using the PDA plate and damp chamber methods. Of the 16 fungi isolated, A. alternata, Aspergillus flavus, A. nidulans, A. niger, and Trichoderma viride were found to be dominant. Culture filtrates of these isolates had much adverse effect on seed germination. Agrosan GN and Ceresan proved effective in controlling the mycoflora to a great extent. Seed germination vigor was increased appreciably by fungicidal treatment.

223. KAMAL, VERMA, A.K., and VERMA, R.P. 1981. Effect of culture filtrates of

certain Aspergilli on germination of arhar (Cajanus cajan [L.] Millsp.) seeds. Biological Bulletin of India 3:183-186.

A few Aspergilli undoubtedly promoted the process of germination and elongation of their radicles and plumules while the remainder retarded the seed germination process. However, the retarding effects were not similar in all the cases.

224. KAMAT, M.N., and PATEL, M.K. 1948. Some new hosts of Oidiopsis taurica (Lev.) Salmon in Bombay. Indian Phytopathology 1:153-158.

This fungus was collected from pigeonpea and other hosts. Each collection would reinfect only its own host; it is therefore highly specialized.

225. KANDASWAMY, T.K., and RAMAKRISHNAN, K. 1960. An epiphytotic of pigeonpea sterility mosaic at Coimbatore. Madras Agricultural Journal 47:440-441.

An epiphytotic of pigeonpea sterility mosaic is reported. No resistance to or tolerance of sterility mosaic was observed in a varietal trial.

226. KANNAIYAN, J., and NENE, Y.L. 1977. Alternaria leaf spot of pigeonpea. Tropical Grain Legume Bulletin 9:34.

Pigeonpea grown at ICRISAT Center was found to be affected by a leaf spot during the 1975-76 season. Initially small necrotic spots appeared on the leaves and these gradually increased in size to characteristic lesions with dark and light brown concentric rings with a wavy outline and a purple margin. As infection progressed, the lesions enlarged and coalesced. The disease was confined mostly to older leaves. The pathogen was brought into pure culture on potato-dextrose agar and pathogenicity was proved on 15-day-old pigeonpea cv Sharda. A detailed study revealed that the fungus is a species of A. tenuissima. This appears to be the first report of this fungus on pigeonpea. Altogether 51 promising pigeonpea lines were scored for this leaf spot disease in the field. Twenty-five lines were found to be free from the disease under field conditions. However, many of the common cultivars (NPWR-15, Sharda, BDN-1, etc.) were susceptible to this leaf spot.

227. KANNAIYAN, J., and NENE, Y.L. 1978. Screening of pigeonpea for resistance to Phytophthora blight. Page 302 in Abstracts of papers of the Third International Congress of Plant Pathology, 16-23 Aug 1978, Munich, Federal Republic of Germany. Berlin, Federal Republic of Germany: Paul Parey.

The blight disease of pigeonpea, caused by Phytophthora sp is serious in some parts of India. A pot-culture technique was standardized for extensive screening to identify sources of resistance. Nine lines/cultivars out of 500 screened were identified as resistant. Their resistances were confirmed under field conditions.

228. KANNAIYAN, J., ERWIN, D.C., RIBEIRO, O.K., and NENE, Y.L. 1979. Phytophthora drechsleri f.sp. cajani, the causal organism of blight of pigeonpea in India. Phytophthora Newsletter 7:32-33.

Several Phytophthora isolates obtained from blighted pigeonpea in India were critically examined and the causal organism was designated as P. drechsleri f.sp. cajani.

229. KANNAIYAN, J., and NENE, Y.L. 1979. Occurrence of powdery mildew on Atylosia species. Tropical Grain Legume Bulletin 15:22-23.

Of the 10 species of Atylosia (wild relatives of pigeonpea), A. albicans, A. grandifolia, A. lineata, and A. rugosa showed slight intensity of powdery mildew, Oidiopsis taurica.

230. KANNAIYAN, J., and NENE, Y.L. 1979. Association of different Fusarium species with wilt disease of pigeonpea. Tropical Grain Legume Bulletin 15:26-27.

In addition to F. udum, F. acuminatum, F. oxysporum, and F. solani were also found associated with pigeonpea wilt.

231. KANNAIYAN, J., NENE, Y.L., and SHEILA, V.K. 1980. Longevity of Phytophthora drechsleri f.sp. cajani in vitro. Phytophthora Newsletter 8:7.

Phytophthora drechsleri f.sp. cajani of pigeonpea survived for a maximum period (133 days) at 15°C on V-8 juice agar.

232. KANNAIYAN, J., NENE, Y.L., and SHEILA, V.K. 1980. Control of mycoflora associated with pigeonpea seeds. Indian Journal of Plant Protection 8:93-98.

Associated with the seeds of four field-grown pigeonpea cultivars, Alternaria sp, Aspergillus flavus, A. niger, Fusarium spp, and Rhizoctonia bataticola were predominant. Cultivars NP-69 (late) and Prabhat (extra early) harbored more fungi than did T-21 (early) or ICP-1 (mid). Genotypic differences rather than weather during pod maturity or different storage periods seem to influence the intensity of seed-borne mycoflora. Greater reduction in seed germination was observed in cultivars NP-69 and Prabhat that had higher frequency of mycoflora, especially Aspergillus spp. Seed treatment with Benlate T at 3 g/kg provided complete control of all seed-borne fungi with no adverse effect on germination. This treatment can be recommended for controlling seed-borne mycoflora to ensure the safe international exchange of seed.

233. KANNAIYAN, J., RIBEIRO, O.K., ERWIN, D.C., and NENE, Y.L. 1980. Phytophthora blight of pigeonpea in India. Mycologia 72:169-181.

A Phytophthora sp was consistently isolated from blighted pigeonpea plants obtained from different locations in India and was confirmed as the cause of the disease. Based on sporangium shape and size, oogonium and oospore formation, temperature requirements, and pathogenicity tests, the isolates are referred to as P. drechsleri f.sp. cajani. The f.sp. was considered appropriate because of the specificity of these isolates to pigeonpea and Atylosia spp (wild relatives of pigeonpea).

234. KANNAIYAN, J. 1981. Diseases observed on pigeonpea in East Africa. International Pigeonpea Newsletter 1:27-28.

A survey was carried out in Kenya, Malawi, Tanzania, and Zambia in 1980 to study the pigeonpea disease situation. Wilt (Fusarium udum) was serious in Malawi, Tanzania, and Kenya. Cercospora leaf spot in Kenya and Malawi, and powdery mildew (Leveillula taurica) in Kenya, Tanzania, and Zambia were important.

235. KANNAIYAN, J., and NENE, Y.L. 1981. Field and greenhouse techniques to screen pigeonpea for resistance to wilt. Pages 277-280 in Proceedings of the International Workshop on Pigeonpeas, 15-19 Dec 1980, ICRISAT Center, India. V.2. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

Efficient field and greenhouse techniques were developed to screen a large number of pigeonpea germplasm accessions and breeding materials for resistance to the wilt disease caused by F. udum. For field screening, uniform wilt-sick plots were developed in Vertisols (3 ha) and in Alfisols (0.5 ha) by repeatedly incorporating chopped wilted plant stubble into the soil and growing susceptible cultivars. In the greenhouse a pot technique consisting of transplanting pigeonpea seedlings in pots filled with infected soil was standardized so as to supplement field screenings.

236. KANNAIYAN, J., and NENE, Y.L. 1981. Greenhouse and field techniques to screen pigeonpea for resistance to Phytophthora blight. Pages 281-284 in Proceedings of the International Workshop on Pigeonpeas, 15-19 Dec 1980, ICRISAT Center. V.2. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

More efficient greenhouse and field techniques to screen pigeonpea germplasm and breeding material for resistance to Phytophthora blight were needed. A simple and efficient technique has been developed for use in both greenhouse (soil drench) and field (stem inoculation) screenings. The greenhouse screening procedure has worked very satisfactorily and a good correlation between greenhouse and field screening has been obtained.

237. KANNAIYAN, J., and NENE, Y.L. 1981. Influence of wilt at different growth stages on yield loss in pigeonpea. Tropical Pest Management 27:141.

Grain yield losses caused by F. udum were nearly 100% when wilt occurred at the pre-pod stage. At the pod maturity stage they were 67.1% and at preharvest stage they were 29.5%. The seed condition (normal or wrinkled) for five growth stages is tabulated.

238. KANNAIYAN, J., NENE, Y.L., RAJU, T.N. and SHEILA, V.K. 1981. Screening for resistance to Phytophthora blight of pigeonpea. Plant Disease 65:61-62.

A simple pot culture technique was used to screen 2835 pigeonpea accessions and cultivars and seven Atylosia spp for resistance to P. drechsleri f.sp. cajani. Seventy-seven germplasm accessions, three cultivars, and two species of Atylosia were found to be resistant. The resistance of 75 of the accessions and cultivars was confirmed under field conditions.

239. KANNAIYAN, J., NENE, Y.L., and REDDY, M.V. 1981. Survival of pigeonpea wilt Fusarium in Vertisols and Alfisols. Pages 291-295 in Proceedings of the International Workshop on Pigeonpeas, 15-19 Dec 1980, ICRISAT Center, India. V.2. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

Wilt caused by F. udum is a major disease of pigeonpea. The capacity of the pathogen to survive in the soil under the wilted plant stubble over a 5-year period was investigated. F. udum could be detected in Vertisols up to 2.5 years and in Alfisols up to 3 years.

240. KANNAIYAN, J., NENE, Y.L., REDDY, M.V., and RAJU, T.N. 1981. International survey of pigeonpea diseases. Pulse Pathology Progress Report no.12. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. 82 pp. (Limited distribution.)

Surveys were conducted to determine the prevalence of pigeonpea diseases in the major pigeonpea-growing areas of Asia, Africa, and the Americas between 1975 and 1980. In India, 11 major pigeonpea-growing states were surveyed and wilt, sterility mosaic, *Phytophthora* blight, *Macrophomina* stem canker, and yellow mosaic were identified as major diseases. The prevalence of other minor diseases was also recorded. The wilt disease was the most serious and widespread in Maharashtra (22.6%), Bihar (18.3%), and Uttar Pradesh (8.2%), and sterility mosaic in Bihar (21.4%), Uttar Pradesh (15.4%), Tamil Nadu (12.8%), Gujarat (12.2%), and Karnataka (9.8%). Disease problems in Bangladesh, Malaysia, and Nepal were of less importance. In Africa, wilt was a serious disease in Malawi (36.3%), Tanzania (20.4%), and Kenya (15.9%). *Cercospora* leaf spot in Kenya and Malawi, and powdery mildew in Kenya, Tanzania, and Zambia were important. Other diseases were not economically important. In the Americas witches' broom, *Phoma* stem canker, and rust were the important diseases. Annual crop losses due to the combined effect of wilt and sterility mosaic diseases in India were estimated to amount to $US 113 million. In Africa the estimated losses from wilt disease alone were over $US 5 million annually.

241. KANNAIYAN, J., REDDY, M.V., and NENE, Y.L. 1981. Survey of pigeonpea diseases with special reference to wilt and sterility mosaic in India. Pages 297-303 *in* Proceedings of the International Workshop on Pigeonpeas, 15-19 Dec 1980, ICRISAT Center, India. V.2. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

To study the prevalence of pigeonpea diseases, roving surveys were conducted in nine states of India during 1975-80. Two diseases--wilt (*F. udum*) and sterility mosaic [virus?]--were more serious and widespread than others such as *Phytophthora* blight, root rots, leaf spots, yellow mosaic, bacterial canker, and powdery mildew. Average percentages of wilt and sterility mosaic were, respectively: Andhra Pradesh 5.3 and 1.6; Bihar 18.3 and 21.4; Gujarat 5.4 and 12.2; Karnataka 1.1 and 9.8; Madhya Pradesh 5.4 and 3.7; Maharashtra 22.6 and 1.1; Rajasthan 0.1 and 5.4; Tamil Nadu 1.4 and 12.8; and Uttar Pradesh 8.2 and 15.4. The incidence of wilt in farmers' fields varied between 0 and 96%; of sterility mosaic, between 0 and 100%.

242. KANNAIYAN, J., REDDY, M.V., NENE, Y.L., and RAJU, T.N. 1981. Prevalence of pigeonpea wilt and sterility mosaic in India (1975-80). International Pigeonpea Newsletter 1:25.

In the 11 states surveyed incidence of *Fusarium udum* varied from 0.1% in Rajasthan to 22.6% in Maharashtra, and of pigeonpea sterility mosaic from 0.2% in West Bengal to 21.4% in Bihar.

243. KERN, D., and THURSTON, H.W. 1954. Additional species of Uredinales from Colombia. Mycologia 46:354-357.

Uromyces dolicholi was recorded in Colombia on pigeonpea.

244. KERNKAMP, M.F., and HEMERIK, G.A. 1953. The relation of *Ascochyta imperfecta*

to alfalfa seed production in Minnesota. Phytopathology 43:378-383.

Pigeonpea reacted positively to inoculation with Ascochyta imperfecta.

245. KHAN, M.W., and SINGH, R.K. 1974. Anthracnose of arhar incited by Colletotrichum truncatum. Indian Phytopathology 27:622-624.

A new record of the occurrence of C. truncatum on pigeonpea from India is reported.

246. KHAN, T.N., and ONIM, J.F.M. 1972. Breeding and genetic improvement of pigeonpea (Cajanus cajan [L.] Millsp.). Annual Project Report, National Research Council, Uganda.

In the first rainy season of 1971 a leaf spot disease (Mycovellosiella cajani) caused severe defoliation and yield losses mainly on introduced cultivars at Aduku and Kabanyolo. The severe injury caused by this disease was shown by the substantial grain yield increase observed when the disease was effectively controlled by the use of foliar fungicides such as Benlate and Dithane M-45 on newly introduced cultivars in the second rainy season of 1971.

247. KHAN, T.N., and RACHIE, K.O. 1972. Preliminary evaluation and utilization of pigeonpea germplasm in Uganda. East African Agricultural and Forestry Journal 38:78-82.

Pigeonpea diseases observed in Uganda were leaf spot (Mycovellosiella cajani), powdery mildew (Leveillula taurica), and wilt (F. udum). Leaf spot appears to be most serious under wet conditions. No pigeonpea line was found immune to Mycovellosiella leaf spot.

248. KHAN, T.N., and ASHLEY, J.M. 1975. Factors affecting plant stand in pigeonpea. Experimental Agriculture 11:315-322.

In Uganda postemergence factors, such as wilt (F. udum), can be controlled by a pigeonpea-cereal rotation.

249. KHANNA, R.N., and SINGH, R.S. 1974. Rhizosphere populations of Fusarium species in amended soils. Indian Phytopathology 27:331-339.

Vegetative growth and sporulation of Fusarium spp in the rhizosphere of pigeonpea increased with plant age. In root-free soil, amendment with oil-cakes and sawdust enhanced the activity of Fusarium spp, the magnitude of stimulation decreasing with passage of time. In the rhizosphere, effects of amendments were altered depending upon the chemical nature of the organic material used. The rhizosphere tended to suppress the stimulatory effect of amendments in the early stages of plant growth and reversed the stimulatory effects of low magnitude into inhibitory effects.

250. KHANNA, R.N. and SINGH, R.S. 1975. Microbial populations of pigeonpea rhizosphere in amended soils. Indian Journal of Mycology and Plant Pathology 5:131-138.

Count of fungi and actinomycetes had an inverse relationship with plant age in a nonamended soil, while optimum bacterial activity occurred at maximum plant vegetative growth. Oil cake was stimulatory to microflora and sawdust was inhibitory. The inhibitory effect was overcome by supplemental nitrogen. Rhizosphere of pigeonpea significantly changed the effect of amendments on microflora. It reduced the stimulatory effects of amendments on bacteria and actinomycetes but accentuated the inhibitory effect of sawdust on these groups.

251. KHUNE, N.N., and KAPOOR, J.N. 1981. A new disease of pigeonpea. Indian Phytopathology 34:258-260.

During the mycological survey of Punjabrao Krishi Vidyapeeth campus, Akola, leaf spots and stem canker symptoms were noticed on local varieties of pigeonpea. The leaf spots were circular to irregular, tan-colored, and surrounded by a margin of darker color. Necrotic tissue became brittle and fell off, resulting in shot-holes. On stems, numerous gray to brown cankerous lesions were formed. In an advanced stage, these coalesced and girdled the stem, being gray in the center with a dark brown margin. Numerous dark brown pycnidia were embedded in the center of the spots. Drying and death of branches from tips downwards were noticed in the affected plants. Phyllosticta cajani was isolated. But the authors have suggested that the fungus should be called Phoma cajani on the basis of the concept developed by H.A. van der Aa.

252. KILLINGER, G.B. 1968. New agronomic crops for Florida. Sunshine State Agricultural Research Report 13:3-5.

Pigeonpea cv Norman, which is a selection from USDA Plant Introduction (PI) 218066 from Pakistan, is reportedly resistant to several species of root-knot nematode (Meloidogyne spp).

253. KILLINGER, G.B. 1968. Pigeonpea (Cajanus cajan [L.] Druce), a useful crop for Florida. Proceedings, Soil and Crop Science Society of Florida 28:162-167.

In field trials at Gainesville, Florida, some mortality of pigeonpea cv Norman was observed under very wet soil conditions. Plants in one field that was heavily shaded until midday were severely attacked by the root-knot nematode Meloidogyne arenaria.

254. KOSHY, P.K., and GOPAL SWARUP. 1971. On the number of generations of Heterodera cajani, the pigeonpea cyst nematode, in a year. Indian Journal of Nematology 1:88-90.

Heterodera cajani could complete nine generations in a year under laboratory conditions. Duration of the life cycle was prolonged during the winter months. The most active periods of multiplication of the nematode were from June to September and April to June.

255. KOSHY, P.K., and GOPAL SWARUP. 1972. Susceptibility of plants to pigeonpea cyst nematode, Heterodera cajani. Indian Journal of Nematology 2:1-6.

One hundred and five plant species, representing 58 genera in 21 families, were tested for their suitability as hosts of H. cajani: 19 of them (family: Leguminosae) were recorded as hosts.

256. KOTASTHANE, S.R., GUPTA, O., and SINGH, B.R. 1980. A new record of parasitic

Cuscuta on pigeonpea. Tropical Grain Legume Bulletin 19:16-18.

Cuscuta hyalina was severely attacked on one of the F2 double-cross entries from ICRISAT (4726 x No. 148) x (C-11 x 4780) pigeonpea population in Jabalpur. This is a new report on pigeonpea.

257. KOTASTHANE, S.R., and GUPTA, O. 1981. Trend of wilting in pigeonpea varieties of variable maturity. Pages 161-162 in Abstracts of papers of the Third International Symposium of Plant Pathology, 14-18 Dec 1981, New Delhi, India. New Delhi, India: Indian Phytopathological Society.

Wilt of pigeonpea caused by F. udum is a serious problem in Madhya Pradesh. Highly susceptible pigeonpea varieties, e.g., AS-3, HY-2, and JA-7 belonging to early, medium, and late types respectively, were sown in the last week of June in an artificially-infested wilt-sick plot to see the trend of wilting. Observations on the number of days to start flowering, incidence of wilt after every 12th day up to the maturity period, and soil temperature were recorded regularly. The observations indicate that an increase in mortality due to wilting starts early, in AS-3, whereas in Hy-2 and JA-7 the mortality starts late in the season. Further, it was noticed that there is a close relationship between flowering period, wilt intensity, and soil temperature. The results suggest that an early-maturity variety, i.e., AS-3, is better for reducing losses due to wilt.

258. KOTWAL, I., VYAS, S.C., VERMA, R.K., and JAIN, A.C. 1981. Translocation and persistence of acylon in pigeonpea. Indian Phytopathology 34:492-493.

The authors report the uptake and the upward and downward translocation of acylon (ridomil), a systemic fungicide, in pigeonpea by seed and root-dip methods. Acylon was found to persist in pigeonpea for a period of 10-12 days.

259. KRAUSS, F.G. 1921. The pigeonpea: its culture and utilization in Hawaii. Bulletin, Hawaii Agricultural Experiment Station 46:1-23.

Pigeonpea was introduced into Hawaii from Puerto Rico. Aspects of pigeonpea agronomy including diseases, are discussed.

260. KRAUSS, F.G. 1932. The pigeonpea (Cajanus indicus): its improvement, culture, and utilization in Hawaii. Bulletin, Hawaii Agricultural Experiment Station 64:46.

Few serious diseases and pests attack pigeonpea in Hawaii. Several important diseases of pigeonpea occurring elsewhere, such as collar rot and stem canker (Physalospora sp) and anthracnose (Colletotrichum cajani), have not been observed in Hawaii and every precaution should be taken to prevent their introduction. Pigeonpea does not appear to be any more susceptible to root-knot nematode than other plant species used as green manure crops in Hawaii.

261. KULKARNI, Y.S., PATEL, M.K., and ABHYANKAR, S.G. 1950. A new bacterial leaf spot and stem canker on pigeonpea. Current Science 19:384.

Symptoms are described after an incubation period of 7 days. The causal organism, X. cajani, is a capsulated, non-acid fast rod, staining readily with common dyes. On PDA colonies are smooth with glistening margins, naphthalene yellcw, reaching a diameter of 1.5 cm in 7 days. The effect of various chemicals was seen on these colonies. Fair growth was seen in Koser's liquid and solid citrate media. The optimum temperature for the development of the pathogen is 30°C and its thermal death point is 51°C.

262. KULKARNI, Y.S., PATEL, M.K., and ABHYANKAR, S.G. 1953. A new bacterial leaf spot and stem canker of pigeonpea. Indian Phytopathology 5:21-22.

The authors give an extended account of the disease and its causal agent and list factors conducive to disease development. Since the pathogen infects pigeonpea alone, showing host range specificity, it is proposed as a new species, to be called Xanthomonas cajani.

263. KUMAR, L.S.S., THOMBRE, M.V., and D'CRUZ, R. 1958. Cytological studies of an intergeneric hybrid of Cajanus cajan (Linn.) Millsp. and Atylosia lineata W. & A. Proceedings of the Indian Academy of Sciences, Section B 47:252-262.

Pigeonpea was crossed with A. lineata in order to combine the wilt resistance of the latter with the desirable agronomic characters of the former.

264. LEACH, R., and WRIGHT, J. 1930. Collar and stem canker of (Cajanus indicus) pigeonpea, caused by a species of Physalospora. Memoirs of the Imperial College of Tropical Agriculture, Trinidad, Mycological Series no.1. 12 pp.

A full account is given in semipopular terms of a collar and stem canker of pigeonpea (Cajanus indicus) in Trinidad. The primary symptoms are the formation of a gray, scutiform, dark-edged lesions averaging 5 cm long on the stem and branches. Many lesions turn dark brown and, at the collar, they generally change into large deep cankers with a verrucose, carbonaceous surface. Usually a canker at the collar girdles and kills the plant. A diagnostic character is the unequal development of the wood near the lesions, which gives the stem a twisted appearance. In later stages, discoloration of internal tissues sometimes extends from a canker for a distance many centimeters along the stem.

Pycnidia of a Phoma and Macrophoma type, which were shown to be stages of Physalospora, were found in young lesions, and inoculations established Physalospora as the cause. A Diplodia with spores measuring 18.9-30.4 and 11.6-13 μ (av. 22.3-11.9 μ) also produced local cankers at the collar, and this fungus is thought to have induced a carbonaceous appearance in the collar cankers caused by the Macrophoma, their rapid enlargement probably being due to the combined action of both fungi. The presence of numerous acervuli of a Myxosporium in twigs killed by the ascomycete also suggested combined fungal action.

The Phoma pycnidia were papillate, variable in size and structure, and united into a stroma in culture, but were found singly in the plant tissues. On the whole of the inner surface they contained minute conidiophores, bearing hyaline, obtuse conidia from 3.1 to 6.2 μ long (average 4 × 1.6 μ).

The Macrophoma pycnidia were similar but not papillate. The elongate subellipsoid to subrhomboid, obtuse conidia measured 18.5-35 μ in length and averaged 24.5 × 7 μ. They were hyaline with nonvacuolated granular contents and had a mucilaginous envelope.

The perithecia were coriaceous, globosa, and short-beaked, varying when mature from 164 to 226 μ in diameter. They contained basally-borne, clavate-cylindrical, apically-thickened asci 126.0-134.8 μ long by 25-35 μ broad. The ascospores were extruded in a gelatinous matrix through a pore formed by the splitting off of an apical cap, and were fusoid-elliptical, with thick walls hyaline, with 1-3 central vacuoles; they measured from 17.5 to 28.0 by 8.7-12.3 μ (av. 24 x 11.1 μ).

Cultural studies are briefly described and the authors provisionally regard the fungus as closely related in the perithecial and pycnidial stages to *P. cydoniae*. Brief recommendations are made for control.

265. LEACH, R. 1934. Report of the Mycologist for 1933. Annual Report of the Department of Agriculture, Nyasaland. pp. 54-55.

Armillaria mellea killed pigeonpeas in an infested tea plantation.

266. LEATHER, R.I. 1967. A catalogue of some plant diseases and fungi in Jamaica. Bulletin, Ministry of Agriculture, Jamaica, New Series no.61.

Diseases of pigeonpea observed in Jamaica were stem canker (*Macrophomina phaseoli*), leaf spot (*Mycovellosiella cajani*), and frog's eye spot (*Phyllosticta cajani*).

267. LICHA-BAQUERO, M. 1980. The witches' broom disease of pigeonpea in Puerto Rico. Journal of Agriculture of the University of Puerto Rico 64:424-441.

Typical witches' broom occurs when leafhoppers of the *Empoasca fabae* complex colonize (in numbers) on field plants. The disease can be reproduced under controlled conditions and can be eliminated by suppression of the insects. Mycoplasma-like organisms were associated with a bushy canopy disease of the pigeonpea plant. This condition should not be confused with the typical witches' broom. No rhabdovirus particles were found in association with the bushy canopy or typical witches' broom diseases. Electron microscopy of tissues from pigeonpea plants with a pale mosaic revealed the presence of rhabdovirus particles. No mycoplasma-like organisms have been found so far in tissues affected by the pale mosaic. No mixed infections were detected in the studies reported.

268. LOPEZ ROSA, J.H. 1969. *Phoma* sp, the causal agent of pigeonpea canker. Phytopathology 59:1348. (Abstract.)

Phoma sp., the causal agent of stem canker of pigeonpea, was isolated from 4% of the seeds produced by canker-affected pigeonpea plants. The fungus was also present on 1% of the seeds harvested in the same locality from plants showing no cankers. Some fungus isolates were extremely virulent on plants of cv Kaki, while the majority were avirulent. Lesions began to appear on leaves and tender stems 48 h after inoculation. However, 4 months after inoculation all stem cankers had healed. The fungus grew well on potato-dextrose agar, corn-meal agar, oat-meal agar, and pigeonpea-pod agar. Production of pycnidia was equally abundant on the above media when the plates were flooded with condidial suspensions. Mature pycnidia were observed 44 h after seeding the plates. Discharge of pycnidiospores was

greatly stimulated by chilling the cultures. The perfect stage, a heterothallic ascomycete, was observed on agar media. Ascospore cultures produced pycnidia in 4 or 5 days.

269. LORDELLO, L.G.E., and VAZ DE ARRUDA, H. 1956. [Nematodes parasitic on pigeonpea.] (In Pt.) Bragantia 15:5-7.

In the state of Sao Paulo, Brazil, pigeonpea roots were severely damaged by parasitic nematodes. Xiphinema campinense and Meloidogyne javanica bauruensis were obtained from diseased pigeonpea roots and surrounding soil. Xiphinema campinense is an ectoparasite of pigeonpea roots while M. javanica bauruensis produces small galls on pigeonpea roots.

270. MAHMOOD, M. 1962. Factors governing the production of antibiotic bulbiformin and its use in the control of pigeonpea wilt. Ph.D. thesis, Indian Agricultural Research Institute, New Delhi, India. 101 pp.

271. MAHMOOD, M. 1964. Factors governing the production of antibiotic bulbiformin and its use in the control of pigeonpea wilt. Science and Culture 30:352.

The incidence of pigeonpea wilt was markedly reduced in soil supplemented with groundnut cake, molasses, and sweet clover root materials on inoculations with B. subtilis which produces bulbiformin.

272. MAITRA, A. 1972. Studies on some aspects of Fusarium wilt of pigeonpea. M.Sc. thesis, University of Kalyani, Kalyani, West Bengal, India. 53 pp.

273. MAITRA, A., and SINHA, A.K. 1973. Partial inhibition of Fusarium wilt symptoms in pigeonpea by non-pathogenic formae of F. oxysporum. Current Science 42:654-656.

Previous inoculation of pigeonpea seedlings with the nonpathogens F. oxysporum f.sp. ciceri and f.sp. vasinfectum delayed the onset of wilt symptoms when the plants were subsequently inoculated with F. oxysporum f.sp. udum. A reduction in the time interval from 6 to 3 days between the two inoculations increased the protective effect. Plants inoculated with F. oxysporum f.sp. ciceri developed gummy brown substances in their vessels, which were never then found to contain fungal hyphae.

274. MALI, V.R., SHIRSAT, A.M., and GODBOLE, G.M. 1977. Occurrence of pigeonpea sterility mosaic in Marathwada. Research Bulletin of the Marathwada Agricultural University 1:148-149.

This sterility mosaic was recorded for the first time in the Marathwada region of Maharashtra state of India. Transmission was possible by bud-grafting; it was also transmitted by mite. The disease was not found to be transmissible by sap.

275. MALIK, R.P. 1945. Collar rot of pigeonpea caused by Pythium aphanidermatum (Edson) Fitz. Indian Journal of Agricultural Sciences 15:92-93.

In isolations made at the Imperial Agricultural Research Institute, New Delhi, in 1943 from wilted pigeonpea plants obtained from the United Provinces, 132 varieties yielded a species of Pythium, Macrophomina phaseoli, a Fusarium distinct from F. udum, and Corticium rolfsii. On potato-dextrose

agar the Pythium formed oogonia measuring 14-34 μ (mean 20 μ) and oospores 12-29 μ (17 μ). The author's isolate is accordingly referred to as P. aphanidermatum. Inoculations with the fungus on pigeonpea stems just above soil-level a few days after sowing caused desiccation of the foliage and young shoots and, in some plants, of the collar region also.

276. MALL, T.P. 1975. Studies on some virus diseases of pigeonpea, Cajanus cajan (L.) Millsp. Ph.D. thesis, University of Gorakhpur, Gorakhpur, Uttar Pradesh, India.

277. MARAMOROSCH, K., and HICHEZ, E. 1973. Rhabdovirus and mycoplasma-like organism: natural dual infection of Cajanus cajan. Phytopathology 63:202. (Abstract.)

Pigeonpea plants with a proliferation disease were observed growing wild on the north shore of Hispanola island in the Dominican Republic near the border of Haiti. Plants were pale green and showed symptoms of witches' broom. Electron micrographs revealed the presence of mycoplasma-like organisms (MLO) as well as bullet-shaped (rhabdo) virus particles in the phloem. The rhabdovirus particles were 45-55 nm in diameter and 240-260 nm in length. This is believed to be the first report of a natural dual infection of a plant by a rhabdovirus and MLO.

278. MARAMOROSCH, K., HIRUMI, H., KIMURA, M., BIRD, J., and VAKILI, N.G. 1974. Pigeonpeas witches' broom disease. Phytopathology 64:582-583 (Abstract.)

Pigeonpea plants with a witches' broom disease of unknown etiology were collected at Rio Piedras and Mayaguez, Puerto Rico. In the sieve tube elements there were large accumulations of mycoplasma-like organisms (MLO) in the diseased plants. Rhabdovirus particles were also detected in the Mayaguez material. Witches' broom disease at Mayaguez might be the result of the combined action of Empoasca toxin, MLO, and virus. The MLO-associated pigeonpea disease of Puerto Rico resembles the MLO and rhabdovirus-associated pigeonpea disease from the Dominican Republic.

279. MARAMOROSCH, K., HIRUMI, H., KIMURA, M., BIRD, J., and VAKILI, N.G. 1974. Diseases of pigeonpea in the Caribbean area: an electron microscopy study. FAO Plant Protection Bulletin 22:32-36.

At least four diseases of uncertain etiology affect pigeonpea. The agent of yellow mosaic disease in Puerto Rico, transmitted by Bemisia tabaci, has not been observed by electron microscopy and may be a viroid. The proliferation or witches' broom disease in the Dominican Republic, and the more severe proliferation disease in Puerto Rico, were associated with mycoplasmas and a rhabdo-type virus. Plants infested by Empoasca leafhoppers in Puerto Rico often showed mild proliferation and typical hopper burn, but no viruses or mycoplasmas were found in them.

280. MARAMOROSCH, K., KIMURA, M., and NENE, Y.L. 1976. Mycoplasma-like organisms associated with pigeonpea rosette disease in India. FAO Plant Protection Bulletin 24:33-35.

Pleiomorphic, mycoplasma-like organisms (MLO) were found in sieve elements of pigeonpea plants with rosette disease. MLO were confined to the phloem and to phloem parenchyma cells. Healthy control plants were free of MLO. Virus or virus-like particles were not detected in these sections.

281. MAREKAR, R.V. 1980. A case of phyllody in pigeonpea. Indian Journal of Heredity 12:63.

Genetic variations were recorded by various scientists in pigeonpea. Natural variation was observed in the Prabhat variety of pigeonpea in the year 1975-76 at the postgraduate experimental area, Department of Botany, Marathwada Agricultural University, Parbhani. Three out of 30 Prabhat plants were found to change all their petals green instead of yellow. These three plants developed their pods up to a certain height from the ground, but no seed setting was achieved. Other characters such as plant height and leaflet condition, remained the same as in the parental line, Prabhat. This phyllody in pigeonpea is reported for the first time.

282. MATHUR, R.S. 1954. Diseases of pulse crops in Uttar Pradesh. Agriculture and Animal Husbandry in India 5:24-28.

The pathogen responsible for pigeonpea wilt inhabits the soil and perpetuates itself from year to year. Sanitation measures, such as rogueing the diseased plants and burning them, are partially helpful. Mixed cropping with sorghum also reduces pigeonpea wilt when sorghum is grown for grain rather than for fodder. But the best solution lies in the use of resistant varieties. For Uttar Pradesh state T-17 variety proved to be tolerant to the disease.

283. McDONALD, J. 1924. Annual report of the Mycologist for the year 1923. Annual Report, Department of Agriculture, Kenya, 1923. pp. 81-85.

Disease similar to that of Madagascar butter beans, caused by a fungus similar to Vermicularia capsici, was observed on pigeonpea.

284. McKIE, M.O.P. 1976. A study of the germination of uredospores of Uredo cajani in tap water, distilled water and 0.5% glucose. B.Sc. Agriculture Project, University of West Indies, St. Augustine, Trinidad, Trinidad and Tobago.

Uredo cajani gives approximately 100% germination in three media: distilled water, tap water, and 0.5% glucose. This implies that the uredospores germinate as long as water is present. Neither the nutrients in the tap water, nor the pH, seems to have any effect on the germination percentage, neither does glucose. The germ tube grew more slowly in tap water and formed appressoria at shorter lengths than in glucose or distilled water.

285. McRAE, W. 1923. Report of the Imperial Mycologist. Scientific Reports of the Agricultural Research Institute, Pusa, 1922-23. pp. 53-60.

Fusarium wilt of pigeonpea was very severe. Manurial experiments indicated superphosphate increased disease incidence and green manure decreased it. The addition of superphosphate to the plots already receiving green manure tends to counteract the favorable effect of the latter.

286. McRAE, W. 1924. Report of the Imperial Mycologist. Scientific Reports of the Agricultural Research Institute, Pusa, 1923-24. pp. 41-51.

Seed-borne spores of F. udum caused little wilt of pigeonpea. Seed disinfection trial on 1 acre (0.4 ha) plots gave 0.04 and 1.4% wilt on treated and untreated plots. The disease was found to spread about 3 m through the soil in 1 season, apparently along roots. Thus previous work on soil treatment was rendered useless. Green manure plus superphosphate reduced wilt incidence by 25%.

287. McRAE, W. 1926. Report of the Imperial Mycologist. Scientific Reports of the Agricultural Research Institute, Pusa, 1925-26. pp. 54-69.

The study of the influence of fertilizers and soil conditions on wilt of pigeonpea due to _F. vasinfectum_ was continued. The average number of wilted plants in the three plots receiving superphosphate was 4 times that in the five plots without superphosphate. In the farmyard manure plot, the number was 7 times the average of those five plots and, in the green manure and superphosphate plot, 6 times. It therefore seems that green manure does not always reduce wilt in a plot receiving only superphosphate. Experiments on the lateral spread of the disease showed that in unmanured land 9, 43, and 88% of infection occurred in three successive years in the plot next to the infected one, but in plots manured with superphosphate contradictory results were obtained. It was again shown that the bulk of the infection comes from the fungus in the soil, and not from spores on the seed. The amount of wilt appears to influenced by the retentive nature of the soil but not directly by its water content.

288. McRAE, W., and SHAW, F.J.F. 1926. Report on experiments with _Cajanus indicus_ (rahar) for resistance to _Fusarium vasinfectum_ (wilt disease). Scientific Reports of the Agricultural Research Institute, Pusa, 1925-26. pp. 208-212.

Progress is reported in the investigation that aims to isolate a race of pigeonpea resistant to wilt disease. Twenty-four selections of seed, 17 from one parent and 7 from another lettered A and B, respectively, were used in the trials. A line of a known susceptible variety was sown alternating with the lines of the selected seeds, and between each row pieces of diseased stem, kept from the previous year, were planted. In the A series the percentage of deaths due to wilt was 9, while that in the susceptible variety was 66. In the B series 54% died from wilt and 79% succumbed among the susceptible race alternating with them. These data suggest that the A series of selections have resulted in the accumulation of a certain amount of resistance, but, owing to a possible variation in the uniformity of infection in different parts of the field, these results need to be checked by reversing the order of the sowing next season.

289. McRAE, W. 1928. Report of the Imperial Mycologist. Scientific Reports of the Agricultural Research Institute, Pusa, 1926-27. pp. 45-55.

The study of the influence of fertilizers on pigeonpea wilt (_F. vasinfectum_) was continued on the permanent manurial plots at Pusa and, as before, the highest incidence was found in the plots receiving superphosphate, except where a green manure was also added, when the percentage of deaths was somewhat less than in the plot receiving a heavy application of nitrogen in farmyard manure without other fertilizers.

290. McRAE, W. 1928. Report of the Imperial Mycologist. Scientific Reports of the Agricultural Research Institute, Pusa, 1927-28. pp. 56-70.

The study of the influence of fertilizers on the incidence of pigeonpea wilt was continued. In general the results observed in the permanent manurial series of plots agreed with those of previous seasons, except that the plot receiving green manure and superphosphate contained a very high proportion of wilted plants (33.8%). The suggestion has been made that some other factor is playing a role.

291. McRAE, W. 1930. Report of the Imperial Mycologist. Scientific Reports of the Agricultural Research Institute, Pusa, 1928-29. pp. 51-66.

Incidence of pigeonpea wilt (*F. vasinfectum*) was favored by superphosphate but checked by green manure and applying both gave intermediate results. One meter of surface soil was dug out and treated with superphosphate (0.002% soluble P_2O_5) and the moisture content was raised to a local optimum before sowing in September after the rains. No further watering was done for 5 months. Larger roots, and the particularly branching rootlets, were the more numerous in the treated top 0.6 m. There was no marked difference in the remaining 0.4 m.

292. McRAE, W. 1931. Note on 'wilt' in rahar in permanent plots at Pusa. Proceedings of the Board of Agriculture of India, 1929. pp. 236-241.

Details are given as a result of a survey of the first 20 years of the permanent manurial plots at Pusa, regarding the influence of fertilizers on the incidence of pigeonpea wilt. The land is double-cropped, in accordance with local custom, and the 2-year rotation consists of maize, pigeonpea, maize, and oats. The effect on disease of the different treatments did not become sufficiently pronounced to attract attention until 1917, when the experiments had been in progress 9 years. In subsequent years counts were made of the number of wilted plants in the different plots (each of 0.1 ha) and from the season 1922-23 until 1927-28 the average results were as follows. In five plots receiving no phosphatic manure and representing plots with no manure and with nitrogen, potash, and green manures, respectively, the average number of wilted plants each year was 241 and 231 for the duplicate series. In three plots receiving superphosphate, either alone or in combination with potassium sulphate or with this plus ammonium sulphate, the average number of wilted plants in the duplicate series was 1122 and 977, respectively. In a plot receiving green manure alone, the average annual incidence in the duplicate plots was 51 and 120 (this latter plot had been subject to flooding), and where green manure and superphosphate were combined the figures were 354 and 605. The average annual percentage of the plants that wilted in the above four groups were: in the duplicate plots 8 and 6, 39 and 22, 1.5 and 4.5, and 14 and 28, respectively. The opinion is expressed that, in a general way, the amount of wilt seems to be correlated with the presence of phosphate.

293. McRAE, W. 1932. Report of the Imperial Mycologist. Scientific Reports of the Imperial Institute of Agricultural Research, Pusa, 1930-31. pp. 73-86.

Further studies confirmed the superiority of A2 (W.R.) type over T-1, the percentages of infection in test rows of which were 1 and 74, respectively. Type A4 also showed a high degree of resistance to wilt (av. 1.8%) infection in six test plots compared with 63% in T-1. On a 27-acre (10.8 ha) field in the regular 3-yr six-crop rotation with pigeonpea once in 3 years, 20 plants were wilted, and in one patch the percentage reached 55. In a field where no regular rotation is followed and pigeonpea has not been grown for 8 years, there were no wilted plants in 11 acres (4.4 ha) of six farm selections and 9 acres (3.6 ha) of A4. Thus the known interval and survival of the fungus in the soil has been reduced from 10 to 8 yr. Of the 41,262 plants inspected in the farmers' fields around Pusa, 2566 (6.2%) were found to be wilted. Further experiments to determine the effect of superphosphate on the development of pigeonpea roots confirmed previous observations showing that both the plants and the wilt fungus grow more vigorously under this treatment.

The seed of pigeonpea plants suffering from partial sterility has been found to produce healthy progeny in two successive seasons, and the injection of leaf juice from diseased into healthy young plants gave negative results.

A *Colletotrichum* attacking pigeonpea at Pusa has been found to agree with *C. cajani* and, in culture, produces an ascigerous stage corresponding in general characters with *Glomerella cingulata*. The leaves and petioles of pigeonpea are further liable to infection by the conidia of a new species of *Cercospora*, two strains of which were observed, one from Allahabad and the other from Pusa. The fungus grows at a temperature range of 6-37°C with an optimum between 27-28°C in alternate light and darkness. Development occurs from 47% relative humidity upwards, but is most profuse at 100%. On a modified Richard's solution, the fungus grows between pH 2.0 and 9.7, with an optimum at 6.7, all concentrations being reduced to about pH 2.9 after 45 days.

294. McRAE, W., and SHAW, F.J.F. 1933. Influence of manures on the wilt disease of *Cajanus indicus* Spreng, and isolation of types resistant to the disease. Part II. The isolation of resistant types. Scientific Monograph, Imperial Council of Agricultural Research, Pusa 7:37-68.

Particulars of selections in progress since 1923 for resistance of pigeonpea to *Fusarium* wilt are described. Type 80 proved highly resistant, and Types 16, 41, 50, 51, and 82 were also resistant. No correlation was found between morphological characters and resistance. A loss of resistance noted in a resistant type grown in a field that had been under the crop for several years was not transmitted to the next generation.

295. MEHTA, P.P., and SINHA, R.K.P. 1982. A new leaf spot disease of arhar from India. Science and Culture 48:44.

Severe infection of leaf spots characterized as black-brownish with prominent black dots was observed in the course of a survey during January 1980 in a Bahar variety of pigeonpea sown in the postrainy season (October), in the experimental plots at Dholi Farm, Rajendra Agricultural University, Bihar. Diseased plants were completely blighted due to the coalescing of the several spots in tender leaves and shoots. The organism isolated invariably revealed the presence of muriform spores of *Alternaria alternata* (Fr.) Keissler.

296. MISHRA, D.P., and GURHA, S.N. 1980. Losses due to yellow mosaic in winter crop of pigeonpea in India. Tropical Grain Legume Bulletin 19:18-19.

The incidence of pigeonpea yellow mosaic virus was higher in the crop sown in September than in that sown in June-July. Yield losses were 22% (trace infected) to 64.3% in heavily-infected plants.

297. MISHRA, D.P., and MEHRA, R.C.S. 1969. Choanephora cucurbitarum on Cajanus cajan in India. Indian Phytopathology 22:515-517.

Choanephora cucurbitarum is recorded on pigeonpea. Symptoms and spread of the disease are described. Infection occurred naturally on several genetic stocks of this host.

298. MISHRA, R.R., and PANDEY, K.K. 1975. Studies on soil fungistasis. Part VII. Studies on colonization of fungi on roots of Cajanus cajan in relation to soil fungistasis. Fertilizer Technology 12:328-330.

The fungistasis of soil samples, collected from different depths and in close proximity to the root surface and the rhizosphere micropopulation, was determined. There was a close correlation between the soil fungistasis and the soil micropopulation.

299. MITRA, M. 1925. Report of the Imperial Mycologist. Scientific Reports of the Agricultural Research Institute, Pusa, 1924-25. pp. 45-57.

The study of the influence of soil and fertilizer conditions on wilt of pigeonpea (F. udum) was continued on the permanent manurial series of plots of the Pusa Farm. The average number of wilted plants in the three plots receiving superphosphate every year was 5 times that in five plots not receiving superphosphate. The number in the green-manured plot was only one-tenth of the average number in those same five plots, while that in the plot receiving both green manure and superphosphate was 1.7 times. It has again been demonstrated that the bulk of the infection originates in the soil, only a small proportion being carried by the seed. The incidence of wilt was found to bear no relation to the moisture content of the soil, which was recorded for each 7.5 cm down to a depth of 60 cm in all the permanent manurial plots on which the incidence of wilt is under study, 4 times during the season. This disposes of the idea that severe wilting is associated with waterlogged soils. The hydrogen ion concentration of the soil was found to be almost identical in all the plots and to vary very little during the season.

300. MITRA, M. 1931. Report of the Imperial Mycologist. Scientific Reports of the Agricultural Research Institute, Pusa, 1929-30. pp. 58-71.

A general survey of farmers' plots of pigeonpea in the vicinity of Pusa showed that, out of a total of 32,703 plants, 4936 or 15.1% were affected by wilt (F. vasinfectum). A wilt of the same host was also caused, though only to a slight extent, by Rhizoctonia (Corticium) solani, inoculations with which gave about 80% positive results.

301. MITRA, M. 1934. Wilt disease of Crotalaria juncea (sunn hemp). Indian Journal of Agricultural Sciences 4:701-714.

Details of cross-inoculation experiments showed that the strains of F. vasinfectum causing wilts of sunn hemp and pigeonpea were similar since cross infection was successful. The cotton strains will not infect these crops, nor will these strains infect cotton. The fungus is often carried on seed. Minor wilting fungi are R. solani and Neocosmospora vasinfecta.

302. MOHAMMED, CAROLINE, L. 1978. Preliminary investigation in pigeonpea rust,

Uredo cajani Syd. M.Sc. thesis, University of West Indies, St.Augustine, Trinidad, Trinidad and Tobago. 190 pp.

Rust intensity increased with the onset of flowering. Determination of spore concentration daily, identifying sources of inoculum, and observing weather conditions, can assist in the prediction of rust disease incidence. No resistant line was found. Many of the new early-maturing cultivars escaped severe infection by maturing before the build-up of an epidemic. Narrow leaflets in the Indian cultivars may possibly increase light infiltration through the plant and minimize shading of lower leaves, thus limiting rust development. There is no evidence for the existence of races in rust fungus in the Caribbean.

303. MOHANTY, U.N. 1942. The wilt disease of pigeonpea (Cajanus cajan [L.] Millsp.) with special reference to some methods of dissemination. Thesis, Indian Agricultural Research Institute, New Delhi, India. 69 pp.

304. MOHANTY, U.N. 1946. The wilt disease of pigeonpea with special reference to the distribution of the causal organism in the host tissue. Indian Journal of Agricultural Sciences 16:379-390.

Fusarium udum, which causes wilt of pigeonpea, forms abundant spore masses on the surface of infected plants. It was found that the spore masses occur only on branches of infected plants at a point considerably below that which the fungus has reached in the tissues, and it is concluded that the spore masses do not form as a result of primary infection in the aerial parts, but arise as a result of the outward spread of the fungus from internally infected branches. The fungus was never found to be carried within the seed. The conidia retain viability for some months. It remains to be determined whether, under field conditions, they can survive from one crop season to the next.

305. MORTON, J.F. 1976. The pigeonpea (Cajanus cajan Millsp.): a high protein, tropical bush legume. Horticultural Science 11:11-19.

In a review article on pigeonpea, some of the more important diseases affecting the roots, stems, foliage, and pods of the crop are discussed.

306. MUKHERJEE, D., DE, T.K., and PARUI, N.R. 1971. A note on the screening of arhar against wilt disease. Indian Phytopathology 24:598-601.

The classification of 58 pigeonpea cultivars according to their reaction to F. udum is presented. None was resistant, but nine were moderately so.

307. MUKIIBI, J. 1976. Possible relationship between intercropping and plant disease problems in Uganda. Presented at the Symposium on Intercropping for Semi-Arid Areas, University of Dar-es-Salaam, 10-12 May 1976, Morogoro, Tanzania.

Pigeonpea diseases were reported to be caused by Rhizoctonia solani, Meloidogyne incognita, Mycovellosiella cajani, Uromyces dolicholi, Leveillula taurica, and F. oxysporum.

308. MULLER, A.S. 1950. A preliminary survey of plant diseases in Guatemala. Plant Disease Reporter 34:161-164.

Foliar diseases caused by *Cercospora cajani* and *Uromyces dolicholi* affect the foliage of pigeonpeas in Guatemala. These diseases did not cause serious damage to the crop.

309. MULLER, A.S. 1953. A foliar disease of legumes in Central America. FAO Plant Protection Bulletin 1:83-84.

Chaetoseptoria wellmani is reported on pigeonpea in Guatemala.

310. MULLER, A.S., and CHUPP, C. 1945. [The Cercosporae of Venezuela.] (In Es.). Boletin de la Sociedad Venezolana de Ciencias Naturales 8:35-59.

Cercospora cajani on pigeonpea is reported.

311. MULK, M.M., and JAIRAJPURI, M.S. 1975. Nematodes of leguminous crops in India. IV. Two new species of *Rotylenchulus filipjer* (Hoplolaimidae). Indian Journal of Nematology 5:9-14.

Observations were made on measurements of the specimens. *R. siddiqui* n.sp., 0.61-0.78 mm long; lip region with indistinct annulations; spear 22-24 µ long; spear knobs rounded, foil hemispherical and phasmids 10-13 striae anterior to the anus. *R. secondus* n.sp. (from pigeonpea) 0.63-0.77 mm long; lip region faintly striated; spear 24-25 µ; spear knobs anteriorly striated, pointed tail cylindroid and phasmids at anal level.

312. MUNDKUR, B.B. 1935. Influence of temperature and maturity on the incidence of sunnhemp and pigeonpea wilt at Pusa. Indian Journal of Agricultural Sciences 5:606-618.

Low soil temperature and increasing maturity appeared to favor wilt incidence in pigeonpea.

313. MUNDKUR, B.B. 1938. Phytopathology - mycology: pigeonpeas. Annual Review of Biochemical and Allied Research in India 9:112.

A survey of relevant literature about the study of cultural characteristics of fungi in pigeonpea is given. Wollenweber reports that pigeonpea that had wilted in characteristic manner in the fields at Pusa yielded the cultures of *F. lateritium* var *uncinatum*. In infective experiments conducted at Berlin Dahlem, the fungus caused a severe foot rot of the crop. This experiment indicates that at least two species -- *F. vasinfectum* and *F. lateritium* var *uncinatum* -- cause diseases of pigeonpea in India.

314. MUNDKUR, B.B. 1946. Report of the Imperial Mycologist. Scientific Reports of the Indian Agricultural Research Institute, 1944. pp. 57-63.

Of 20 pigeonpea varieties tested in pots against wilt (*F. udum*) in 1942-43, A 126-4-1 was affected. In 1943-44, IP-80, IP-41, C 38, C 15, A 126-4-1, D 16-17-2, PT.12, and D 33-4-22 were resistant. Bulsar white, reputedly resistant, was severely infected. In field plots inoculated with cultures of fungus and infected debris, D 16-17-2, PT.12, and D 33-4-22 lost resistance.

315. MURTHY, G.S. 1975. Studies on the nature of resistance in *Cajanus cajan* (L.) Millsp. against wilt caused by *Fusarium udum* Butl. Mysore Journal of Agricultural Sciences 9:716-717.

Analysis of two varieties indicates that resistance was associated with a higher content of total sugar, reducing sugars, amino nitrogen, amino acids, phenols, flavanols, and alkaloids. The resistant variety also contained higher amounts of xylose, cysteine, and tryptophan, and lower amounts of phenylalanine. Bioassay revealed that caffeic and chlorogenic acids and an unidentified phenolic compound, which were present in the resistant variety, inhibited spore germination. It is considered that cysteine counteracts fungal infection by chelating ferric ions that activate the *Fusarium* toxin.

316. MURTHY, G.S., and BAGYARAJ, D.J. 1978. Free amino nitrogen and amino acids in *Cajanus cajan* in relation to *Fusarium* wilt resistance. Indian Phytopathology 31:482-485.

Pigeonpea cultivars, resistant and susceptible to *F. udum*, were analysed to determine their free amino nitrogen and amino acid contents. The resistant cultivar C-11-6 contained larger concentrations of amino nitrogen than the susceptible cv TS-136-1. Cysteine and tryptophan were detected only in the shoots of the resistant cultivar. Concentrations of alanine were greater in the resistant cultivar, but concentrations of phenylalanine were greater in the susceptible cultivar. The role of cysteine in disease resistance is discussed.

317. MURTHY, G.S., and BAGYARAJ, D.J. 1978. Rhizosphere microflora of *Cajanus cajan* in relation to *Fusarium* wilt resistance. Plant and Soil 50:485-487.

Screening of rhizosphere isolates revealed no potent antagonists against *F. udum*, suggesting that resistance in the pigeonpea cv C-11-6 is not due to the presence of antagonists.

318. MURTHY, G.S., and BAGYARAJ, D.J. 1980. Flavanol and alkaloid content of pigeonpea cultivars resistant and susceptible to *Fusarium udum*. Indian Phytopathology 33:633-634.

Flavanol as well as total alkaloids were found in higher concentrations in the resistant cultivar than in the susceptible at all stages of plant growth.

319. NAMBIAR, K.K.N. 1967. Studies on pigeonpea sterility mosaic disease. Ph.D. thesis, University of Madras, Madras, Tamil Nadu, India.

320. NAMBIAR, K.K.N., and RAMAKRISHNAN, K. 1968. Studies on pigeonpea sterility mosaic disease. VI. Effect of disease on carbohydrates. Proceedings of the Indian Academy of Sciences, Section B 63:295-300.

Total carbohydrates were significantly lesser in diseased than in healthy plants, increasing with age in the latter. The diseased leaves had a higher content of reducing sugars than healthy leaves of corresponding ages, but less starch and resin.

321. NAMBIAR, K.K.N., and RAMAKRISHNAN, K. 1969. Studies on pigeonpea sterility mosaic disease. VII. Effect on mineral metabolism. Proceedings of the Indian Academy of Sciences, Section B 70:37-41.

Ca, K, Na, and Mn contents were lower in diseased than in healthy plants, Ca decreasing with the age of the leaves.

322. NAMBIAR, K.K.N., and RAMAKRISHNAN, K. 1969. Studies on pigeonpea sterility mosaic virus. VIII. Effect on photosynthesis and nucleic acids of pigeonpea leaves. Phytopathologisch Zeitschrift 66:91-94.

A significant reduction in photosynthesis and rate of Hill reaction was recorded in diseased leaves, photosynthesis being least in the yellow patches. RNA and DNA levels were higher in diseased leaves of all ages. RNA fractions presumably contained viral as well as plant RNA.

323. NAMBIAR, K.K.N., and RAMAKRISHNAN, K. 1969. Studies on pigeonpea sterility mosaic disease. IX. Effect on nitrogen metabolism. Proceedings of the Indian Academy of Sciences, Section B 70:200-207.

Total N was higher in diseased than in healthy leaves at all ages. All forms of N, except ammoniacal and nonprotein, were increased. Free amino acids -- valine, leucine, and arginine -- were at higher concentrations in younger than in older diseased leaves. The high concentration of amino acids in the bound form in diseased leaves suggests their probable incorporation into the virus protein.

324. NARAYANASWAMY, P., SESHADRI, A.R., and RAMAKRISHNAN, K. 1963. Preliminary note on suspected nematode transmission of redgram sterility mosaic virus. Madras Agricultural Journal 50:109-110.

The disease was observed in the field where the crop was sown for the first time, but it occurred in high percentage in the fields where it was grown successively. The virus is probably transmitted by one or more of the soil nematode species listed in the text.

325. NARAYANASWAMY, P. 1964. Studies on the sterility mosaic disease of red gram. Ph.D. thesis, University of Madras, Madras, Tamil Nadu, India.

326. NARAYANASWAMY, P., and RAMAKRISHNAN, K. 1965. Studies on sterility mosaic disease of pigeonpea. I. Transmission of the disease. Proceedings of the Indian Academy of Sciences, Section B 62:73-86.

The pigeonpea sterility mosaic was not transmitted by sap or insects. There were indications to show that the disease was probably soil-borne. Decrease in nematode population reduced disease incidence, the reduction being greater in DD-treated plots than in Nemagon-treated plots. It is surmised that the disease is probably transmitted by Rotylenchulus reniformis and/or Tylenchorhynchus spp. A negative correlation was obtained between the population of plants and percentages of infection.

327. NARAYANASWAMY, P., and RAMAKRISHNAN, K. 1965. Studies on sterility mosaic disease of pigeonpea. II. Carbohydrate metabolism of infected plants. Proceedings of the Indian Academy of Sciences, Section B 62:130-139.

The reduction in the chlorophyll content in virus-diseased pigeonpea leaves was as high as 60.9%. Carotene and xanthophyll contents of diseased leaves also showed a decrease, as did the total carbohydrate content. The activity of chlorophyllase was increased due to virus infection. The synthesis of sucrose in diseased leaves was at a lower rate than in healthy ones and resulted in a derangement of photosynthetic activity in diseased plants. The translocation of sugars was reduced and the nature of sugars translocated was altered in the diseased plants.

328. NARAYANASWAMY, P., and RAMAKRISHNAN, K. 1966. Studies on the sterility mosaic disease of pigeonpea. III. Nitrogen metabolism of infected plants. Proceedings of the Indian Academy of Sciences, Section B 63:288-296.

A decrease in the chloroplastic protein and a slight increase in the cytoplasmic protein was seen in the diseased leaves. There was no appreciable quantitative difference in the amino acid content of proteins of healthy and diseased plants. The total nitrogen content of the diseased leaves showed a progressive increase over healthy ones during the day, from morning until evening. The free amino acids of diseased leaves showed variations both in quality and quantity. The presence of two unidentified amino acids was detected only in diseased leaves. The amino acids alanine, asparagine, aspartic acid, and arginine, which were in very high concentrations in diseased leaves at 6 a.m., were either completely absent or present only in very small amounts at 6 p.m. A decrease in the C:N ratio resulted from virus infection.

329. NARAYANASWAMY, P., and RAMAKRISHNAN, K. 1966. Studies on sterility mosaic disease of pigeonpea. IV. Changes in activity of enzymes in diseased plants. Proceedings of the Indian Academy of Sciences, Section B 64:78-82.

The diastatic activity in pigeonpea leaves infected by pigeonpea sterility mosaic virus was greater than in the healthy leaves. Very low peroxidase activity was noticed in diseased leaves. The catalase activity in infected leaves was increased slightly. The activities of nitrate reductase and proteolytic enzymes in the diseased leaves showed an increase over the healthy leaves. The significance of these changes is discussed.

330. NARAYANASWAMY, P., and RAMAKRISHNAN, K. 1966. Studies on the sterility mosaic disease of pigeonpea. V. Organic acid metabolism and respiration of infected plants. Proceedings of the Indian Academy of Sciences, Section B 64:135-142.

A general reduction in the organic acid contents of leaf, petiole, stem, and buds of diseased plants was observed. Ascorbic acid contents of different tissues exhibited a reduction. Maleic acid and citric acid were absent in diseased leaves and petioles respectively; citric acid and succinic acids accumulated in the stem and root, respectively, of the diseased plants. The rate of respiration was increased in diseased plants throughout the day.

331. NARAYANASWAMY, P., and JAGANATHAN, T. 1975. A note on powdery mildew disease of pigeonpea (_Cajanus cajan_ [L.] Millsp.). Science and Culture 41:133-134.

The disease was generally seen on young leaves. Stem and petioles also showed symptoms. In severe cases, the affected leaves turned yellow, exhibiting crinkling. This species, _Oidiopsis taurica_, did not produce a perfect stage. Pigeonpea was reported as a new host for this fungus.

332. NATTRASS, R.M. 1958. Report of the senior Plant Pathologist. Report, Department of Agriculture, Kenya, 1956. Pt.2. pp. 9-14.

The occurrence of a bark disease on pigeonpea, showing short longitudinal splits and stem-pitting and leading to dieback and collapse, is noted.

Cercospora cajani and *Uromyces dolicholi* were found as new records.

333. NAYLOR, A.G. 1974. Diseases of plants in Jamaica. Kingston, Jamaica: Ministry of Agriculture, Agricultural Information Services, 129 pp.

Diseases of pigeonpea observed in Jamaica were rust (*Uredo cajani*), witches' broom, and yellow mosaic.

334. NEMA, K.G. 1950. Inhibitory effect of certain soil microorganisms on *Fusarium udum* Butler, the pigeonpea (*Cajanus cajan* [L.] Millsp.) wilt organism. Thesis, Indian Agricultural Research Institute, New Delhi, India. 54 pp.

335. NENE, Y.L. 1972. A survey of viral diseases of pulse crops in Uttar Pradesh. Research Bulletin no. 4. Pantnagar, Uttar Pradesh, India: Govind Ballabh Pant University of Agriculture and Technology. 191 pp.

Two viral diseases of pigeonpea, sterility mosaic and yellow mosaic, were investigated, of which the former is the most important. The symptoms of sterility mosaic were studied in detail. Transmission through an eriophyid mite, *Aceria cajani*, was confirmed. Graft transmission was also successful but dodder, sap, seed, and soil transmission were unsuccessful. If the infection took place early the yield losses were complete. The yellow mosaic of pigeonpea was found to be caused by mung bean yellow mosaic virus (MYMV) and was found to be transmitted through whitefly, *Bemisia tabaci*.

336. NENE, Y.L. 1973. Viral diseases of some warm weather pulse crops in India. Plant Disease Reporter 57:463-467.

Four viral diseases attacking a large number of pulse crops were investigated. Mung bean yellow mosaic virus, transmitted by the whitefly, *Bemisia tabaci*, is the most widespread and causes serious losses. It affects several pulse crops including pigeonpea.

337. NENE, Y.L., and REDDY, M.V. 1976. A new technique to screen pigeonpea for resistance to sterility mosaic. Tropical Grain Legume Bulletin 5:23.

Brief notes are given on the leaf-stapling technique in which leaflets from diseased plants infested with mites (*Aceria cajani*) are stapled to the primary leaves of test seedlings. The superiority of this technique over the twig-tying technique is indicated.

338. NENE, Y.L., and REDDY, M.V. 1976. Screening for resistance to sterility mosaic of pigeonpea. Plant Disease Reporter 60:1034-1036.

Sterility mosaic (SM) is widely prevalent in the Indian subcontinent, producing complete or partial sterility in affected plants. In some fields 100% incidence was observed. Transmission of the causal agent is through the eriophyid mite, *Aceria cajani*. Two thousand eight hundred and four accessions, including pigeonpea germplasm/cultivars, *Atylosia* spp., and pigeonpea x *Atylosia* crosses, were screened for resistance to SM by utilizing a leaf-stapling inoculation technique. Four pigeonpea lines -- ICRISAT-3783, -6986, -6997, -7035 -- and one cultivar (ICRISAT-7119 or Hy-3C) were identified as immune. Lines showing other desirable characters, including longer incubation period, less disease incidence, mild symptoms, and flowering in spite of infection, were also identified.

339. NENE, Y.L. 1977. Survey of pigeonpea diseases with special reference to wilt and sterility mosaic diseases. Presented at the All India Workshop on Assessment of Crop Losses due to Pests and Diseases, 19-30 Sept 1977, University of Agricultural Sciences, Bangalore, Karnataka, India. 34 pp.

During roving surveys it was found that two diseases, wilt (_F. udum_) and sterility mosaic (virus?), were more serious than others such as leaf spots and powdery mildew. The average wilt inidence varied from 1.12 to 22.61%. The average sterility mosaic incidence was 1.09 to 12.84%. In some of the farmers' fields the incidence of wilt varied from 0 to 93% and sterility mosaic from 0 to 95%.

340. NENE, Y.L., and REDDY, M.V. 1977. Leaf stapling technique to screen pigeonpea for resistance to sterility mosaic. Indian Phytopathology 30:153.

The technique involved the stapling of diseased leaflets bearing 50-139 mites onto healthy ones with a Max-10 stapler. The technique, using 2-9 diseased leaflets, was compared with the twig-tying technique on cv Sharada plants and was found to be significantly superior. Symptoms appeared in 1 week as compared with 2-3 weeks in the twig-tying technique. Infection percentage was directly proportional to the number of diseased leaflets used as inoculum and was found to be negatively correlated with the age of seedlings. Maximum infection was obtained at the first trifoliate stage.

341. NENE, Y.L. 1978. Major disease problems of some grain legume crops in India. Pages 1-11 _in_ Proceedings of the Plant Protection Conference, 22-25 Mar 1978, Kuala Lumpur, Mayalysia. Kuala Lumpur, Malaysia: Rubber Research Institute of Malaysia.

Chickpea "wilt complex", pigeonpea wilt and sterility mosaic, and yellow mosaics of soybean and mung bean, are discussed.

342. NENE, Y.L. 1980. A world list of pigeonpea and chickpea pathogens. Pulse Pathology Progress Report no. 8. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. 14 pp. (Limited distribution.)

Fifty-eight pathogens reported or observed on pigeonpea are listed.

343. NENE, Y.L., KANNAIYAN, J., HAWARE, M.P., and REDDY, M.V. 1980. Review of the work done at ICRISAT on soil-borne diseases of pigeonpea and chickpea. Pages 3-47 _in_ Proceedings of the Consultants' Group Discussion on the Resistance to Soil-Borne Diseases of Legumes, 8-11 Jan 1979, ICRISAT, Hyderabad, India. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

Work done by ICRISAT scientists on pigeonpea wilt (_F. udum_) and _Phytophthora_ blight (_P. drechsleri_ f.sp. _cajani_) has been reviewed in detail.

344. NENE, Y.L., KANNAIYAN, J., and REDDY, M.V. 1981. Resistance to major pigeonpea diseases. Pages 121-128 _in_ Proceedings of the International Workshop on Pigeonpeas, 15-19 Dec 1980, ICRISAT Center, India. v.l. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

Wilt (F. udum), sterility mosaic (virus?) and Phytophthora blight (P. drechsleri f.sp. cajani), witches' broom (virus and mycoplasma?), rust (Uredo cajani), and leaf spot (Cercospora cajani), are some of the important diseases of pigeonpea. Good sources of resistance to wilt, sterility mosaic, Phytophthora blight, and leaf spot are available.

345. NENE, Y.L., KANNAIYAN, J., and REDDY, M.V. 1981. Pigeonpea diseases: resistance-screening techniques. Information Bulletin no. 9. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. 14 pp.

Over 50 diseases have been reported to affect pigeonpea, a widely-grown tropical legume crop. Economically important diseases are wilt, Phytophthora blight, sterility mosaic, witches' broom, and rust. To assist plant breeders develop disease-resistant material, easy and effective techniques to screen germplasm and breeding material have been developed and standardized for some diseases. Details of these techniques are given, supported by 23 color illustrations and a nine-point rating scale for a ready identification of resistant breeding material.

346. NENE, Y.L., KANNAIYAN, J., REDDY, M.V., and REMANANDAN, P. 1981. Sources of resistance to selected pigeonpea diseases. Pulse Pathology Progress Report no. 16. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. 34 pp. (Limited distribution).

Details are given of the screening techniques adopted and sources of resistance to wilt (Fusarium udum), pigeonpea sterility mosaic (virus?), and Phytophthora blight (Phytophthora drechsleri f.sp. cajani).

347. NENE, Y.L., REDDY, M.V., and DEENA, E. 1981. Modified infector-row technique to screen pigeonpea for sterility mosaic resistance. International Pigeonpea Newsletter 1:27.

A four-row hedge of a susceptible cultivar on the west side of a 2-ha field was inoculated with pigeonpea sterility mosaic virus by leaf-stapling. The test materials, with indicator rows of a susceptible cultivar after every 10 rows (9 m), were sown in June. From then until October the prevailing winds carried the vectors from the hedge across the nursery. Average incidence on the indicator rows 104 days after planting was 98.7%.

348. NEWTON, W., and PEIRIS, J.W.L. 1953. Virus diseases of plants in Ceylon. FAO Plant Protection Bulletin 2:17-21.

Pigeonpea in Sri Lanka is affected by yellow mosaic and pale mosaic. Symptoms of both virus infections are described. Yellow mosaic, characterized by a bright yellow, blotchy foliage mottle, does not seriously reduce yields, and its incidence seldom exceeds 10% at seed maturity. It appears to be confined to the dry-farming regions of the north central dry belt. Pale mosaic, characterized by vein-banding followed by the development of a pale green mottle, has been found only in the wet zone, near Peradeniya. Unlike yellow mosaic, it spreads rapidly. Sap-inoculated to Psophocarpus tetragonolobus, yellow mosaic virus produced conspicuous vein-banding on the new foliage in 10-15 days, followed by a yellowish mottle, whereas the pale mosaic virus had no effect in 20 days.

349. NICHOLS, R. 1965. Studies on the major element deficiencies of the pigeonpea (Cajanus cajan) in sand culture. Plant and Soil 21:377-387.

A description of symptoms in nodulated and nonnodulated plants with an analytical key for foliar diagnosis of the deficiencies.

350. NIRULA, K.K. 1980. Quarantine to seed exchange at the ICRISAT. Seed Pathology News 13:11-12.

Pigeonpea seed should be harvested from healthy plants. No particular restrictions are prescribed by the national quarantine authorities. The quarantine-objectionable pathogens are Colletotrichum cajani and Xanthomonas cajani.

351. NOWELL, W. 1923. Diseases of crop plants in the Lesser Antilles. London, UK: West India Comm. 383 pp.

In the West Indies there are two or three fungal diseases that affect the roots, collar, or lower stem of pigeonpea which may cause death of diseased plants. Rosellinia sp is another fungus that attacks pigeonpea roots. In 1917 young and old pigeonpea plants on Carriacou in the Grenadines were affected by a serious stem and collar disease. A similar disease was observed attacking young plants on the island of Bequia. The only fungus consistently associated with the disease was an ascomycete that formed perithecia and pycnidia in the bark of affected areas. No infection resulted when plants were inoculated during the dry season. A wilt disease, apparently affecting the roots, occurred sporadically in Barbados. Rust (Uromyces dolicholi) affects pigeonpea foliage in Trinidad and Puerto Rico.

352. OLDFIELD, G.N. 1970. Mite transmission of plant viruses. Annual Review of Entomology 15:343-380.

The eriophyid transmission of some plant viruses is discussed. Pigeonpea sterility mosaic disease is mentioned.

353. OLDFIELD, G.N., REDDY, M.V., NENE, Y.L., and REED, W. 1981. Preliminary studies of the Eriophyid vector of sterility mosaic. International Pigeonpea Newsletter 1:25-26.

The results of a preliminary study of the biology of Aceria cajani are given. The eggs, measuring 30 x 40 μ, parallel-sided and rounded at the ends, were found loosely attached to a filamentous trichome of the vegetative tips of plants. These were slightly smaller than glandular trichomes and milky white. The eggs usually hatch after 4-5 days. The females laid 1-3 eggs daily. The males are slightly smaller than the females. The spermatophore is stalked and firmly attached to the leaf on an expanded base.

354. ONIM, J.F.M. 1974. Improvement of pigeonpea. Development of resistance to Mycovellosiella cajani. M.Sc. thesis, Makerere University, Uganda.

355. ONIM, J.F.M., and RUBAIHAYO, P.R. 1976. Screening pigeonpea for resistance to Mycovellosiella cajani. SABRAO Journal 8: 121-125.

Of 15,000 plants (2107 cvs), 314 were selected for resistance to M. cajani. When progeny lines from 11 of these selections were grown at five sites in

Uganda and Kenya, lines UC 2515/2, UC 796/1, UC 2113/1, and UC 2568/1 were resistant and gave high yields. Disease incidence was significant and negatively correlated with yield.

356. ONIM, J.F.M. 1980. Foliar fungicides for the control of Mycovellosiella cajani causing the leaf spot of pigeonpea. Indian Journal of Agricultural Sciences 50:615-619.

Mycovellosiella cajani (Henn) Rangel ex Trotter, the causal organism of leaf spot of pigeonpea, reduced the yield by 85%. The disease was effectively controlled by Dithane M-45 and Benlate when sprayed at intervals of 7-21 and 14-21 days, respectively. Karathane did not control the disease, whereas Bavistin and Benlate significantly ($P = 0.001$) depressed the grain yield when sprayed weekly.

357. ORILLO, F.T., and VALDEZ, R.B. 1958. Four diseases of coffee hitherto undescribed in the Philippines. Philippine Agriculturist 42:292-302.

Rhizoctonia blight was observed on pigeonpeas used as temporary shade for coffee transplants. It killed all infected plants and produced many large light brown sclerotia on the leaves. The disease also caused defoliation of coffee, but no sclerotia formed. Symptoms and culture are described.

358. PADWICK, G.C. 1939. Report of the Imperial Mycologist. Scientific Reports of the Imperial Agricultural Research Institute, Pusa, 1937-38. pp. 105-112.

Several distinct species of Fusarium were isolated from wilted pigeonpeas. One appeared to differ from F. udum, and to produce severe wilting but no foot-rot. Its identity is being established.

359. PADWICK, G.W. 1940. The genus Fusarium. 5. Fusarium udum Butler, F. vasinfectum Atk. and F. lateritium nees var. uncinatum Wr. Indian Journal of Agricultural Sciences 10: 863-878.

Full descriptions of the cultural characters of various isolates of Fusarium, causing wilt in cotton, pigeonpea, and sunnhemp, are given. The author suggests the name F. udum Butl. var cajani for the pigeonpea wilt organism because it is morphologically and culturally identical with, but pathogenically different from, the one causing sunnhemp wilt.

360. PADWICK, G.W. 1940. Report of the Imperial Mycologist. Scientific Reports of the Imperial Agricultural Research Institute, Pusa, 1939-40. pp. 103-115.

Cross-inoculation tests with Fusarium wilt fungi are described.

361. PADWICK, G.W., MITRA, M., and MEHTA, P.R. 1940. The genus Fusarium. IV. Infection and cross-infection tests with isolates from cotton (Gossypium sp.), pigeonpea (Cajanus cajan) and sunn-hemp (Crotalaria juncea). Indian Journal of Agricultural Sciences 10:707-715.

With a view to reconciling the conflicting evidence regarding the ability of the species of Fusarium -- isolated from cotton, pigeonpea, and Crotalaria juncea -- to pass from one host to another and cause infection, the authors carried out isolation and cross-inoculation experiments with 51 isolates from all three hosts. Only one of the 16 cotton isolates caused wilting, but a number of them prevented normal germination of one or more of the three hosts. For instance, F-140 practically inhibited the germination of cotton and pigeonpea, F-142 exerted a very adverse effect on cotton and C. juncea but not on pigeonpea, while F-153 was detrimental to all three. None of these cotton isolates appeared to be capable of causing wilt at a later stage in the development of the plants. Owing to the appearance of a certain number of wilted plants in the controls, only a minimum of 10 wilted plants was accepted as a reliable index of pathogenicity. On this basis the results clearly showed that most of the wilt-producing strains are almost, if not entirely, restricted to the original host, except that F-13 and F-15, isolated from C. juncea, induced wilting of pigeonpea, possibly because these isolations were made before the technique had been perfected and may have come from the superficial cortical tissue. It is of interest to note that the most severely pathogenic isolates made only poor or moderate growth on the mixture of soil and maize meal used as inoculum, whereas the relatively innocuous strains ramified in the substratum and produced considerable aerial mycelium.

362. PAL, B.P. 1934. Recent progress in plant breeding at Pusa - rahar. Agriculture and Livestock in India 4:511-512.

In an investigation undertaken to produce types of pigeonpea resistant to wilt (F. vasinfectum Atk.), 80 types that proved very resistant to the disease were isolated. The resistance is not correlated with any important morphological characters. Types 16, 41, 50, and 51 were identified as high-yielding. Type 51 is erect, wilt-resistant, with large yellow-brown seeds. It yields well and should prove to be of much economic value. Type 5 is extremely susceptible to wilt. The inheritance of flower color depends upon two factors and is linked with those for morphological characters. Inheritance of resistance depends upon multiple factors.

363. PAL, M., GREWAL, J.S., and SARBHOY, A.K. 1970. A new stem rot of arhar caused by Phytophthora. Indian Phytopathology 23:83-87.

A new disease caused by P. drechsleri Tucker var cajani was observed in severe form on pigeonpea T-21 at Delhi and Kanpur during 1968-69. Affected plants dry up rapidly, causing total loss to the crop. Brown to dark brown lesions, distinctly marked from dark green healthy portions on the stem, appear at ground level or a few centimeters higher. High humidity coupled with the disease may cause the rapid development of stem rot.

364. PAL, M., and GREWAL, J.S. 1975. Physiological studies on Phytophthora drechsleri var. cajani. Indian Phytopathology 28:479-482.

Phytophthora drechsleri var cajani was grown on five synthetic media. Mehrotra's medium and a 3-week incubation period were found to be optimum for the growth of the fungus. Maximum growth of the fungus was recorded at pH 6.5 and the optimum temperature for the growth of the fungus was 30°C. The fungus was also grown on 14 different carbon sources. Growth was significantly good on hexoses (D-glucose, D-fructose, D-mannose, and D-galactose) which was followed by growth on sucrose, maltose, and starch. Raffinose, insulin, sorbitol, mannitol, D-xylose, and lactose were found to be poor carbon sources for the growth of the fungus. The growth was negligible in the absence of carbon, and also on arabinose.

365. PAL, M., and GREWAL, J.S. 1975. Utilization of different nitrogen sources by *Phytophthora drechsleri* var *cajani*. Indian Phytopathology 28:499-501.

Ammonium salts in general supported good growth of *P. drechsleri* var *cajani*, indicating better utilization of ammoniacal nitrogen with maximum growth on ammonium nitrate. Growth was poor on calcium nitrate. Sodium nitrite was not utilized at all. Moderate to good growth of the fungus was recorded on monoamino dicarboxylic amino acids and amides; i.e., L-aspartic acid, L-glutamic acid, L-asparagine, and glutamine.

366. PAL, M., and GREWAL, J.S. 1975. Resistance of pigeonpea to *Phytophthora* blight. 1. Total phenolic content. Indian Phytopathology 28:559-560.

The total phenolic content in leaves of the resistant variety AS-3, measured 4-6 days after inoculation with *P. drechsleri* var *cajani*, was greater in inoculated than in uninoculated plants. In the susceptible variety T-21 it was greater in the leaves of uninoculated plants.

367. PAL, M., and GREWAL, J.S. 1976. Effect of NPK fertilizers on the *Phytophthora* blight of pigeonpea. Indian Journal of Agricultural Sciences 46:32-35.

In the absence of K, high doses of N increased the incidence of *P. drechsleri*. Addition of K decreased the incidence regardless of the presence or absence of N or P in the soil. P had little effect on the disease.

368. PAL, M., and GREWAL, J.S. 1976. Resistance of pigeonpea to *Phytophthora* blight. II. Total reducing and non-reducing sugars. Indian Phytopathology 29:429-431.

Nonreducing sugars increased with the sampling interval and decreased significantly after infection, but the decrease was more pronounced in the susceptible variety than in the resistant one.

369. PAL, M., and GREWAL, J.S. 1978. Growth of *Phytophthora drechsleri* var. *cajani* on different vitamins. Indian Phytopathology 31:536-538.

Phytophthora drechsleri var *cajani* was grown on a vitamin- free medium by adding eight vitamins, individual as well as different combinations, omitting one vitamin at a time. The fungus showed partial deficiency for thiamine. Maximum growth of the fungus was recorded at 20 ppm of thiamine. Riboflavin, folic acid, and calcium pantothenate supported poor growth. Growth was moderate on nicotinic acid and good on biotin, ascorbic acid, and pyridoxine.

370. PANDEY, K.K., MISHRA, G.S., and GROVER, S.K. 1976. Some studies on chemosterilants. I. Thiourea as fungus growth inhibitor. Science and Culture 42:476-477.

Increasing concentrations of thiourea caused a gradual decrease in the mycelial dry weight and sugar content of *Helminthosporium sativum* (*Cochliobolus sativus*) and *F. oxysporum* f.sp. *udum* (*F. udum*).

371. PARK, M. 1929. Report of the Mycological Division. Technial Report, Department of Agriculture, Ceylon, 1928. pp. 1-6.

A new record of *Oidiopsis* sp that causes powdery mildew of pigeonpea leaves

is reported.

372. PARK, M. 1935. Report of the work of the Mycological Division. Report of the Directorate of Agriculture, Ceylon, 1934. pp. D 124-D 131.

Rust is recorded on pigeonpea as Woroninella umbilicata.

373. PATEL, M.K., and KULKARNI, Y.S. 1949. Nitrogen utilization by Xanthomonas malvacearum (SM) Dowson. Indian Phytopathology 2:62-64.

The nitrogen requirements of F. udum were investigated, together with those of other fungi and bacteria. The source of N is not the only factor of importance for the growth of microorganisms; the source of C is also very important.

374. PATEL, M.K., and KAMAT, M.N. 1950. Control of plant disease through disease resistance in Bombay. Poona Agricultural College Magazine 40:6-11.

A general discussion on breeding for disease resistance is presented and the technique used in India for obtaining crop plants resistant to Fusarium wilt is outlined. In pigeonpea much reliance was previously placed on field resistance to wilt, but the results of a pot test under uniform conditions at Poona have demonstrated the need for the standardization of the breeding technique.

375. PATEL, M.K., and KAMAT, M.N. 1950. Control of plant diseases through disease resistance in Bombay. Proceedings of the Indian Science Congress, 37 (pt.3):86.

Methods are suggested for testing pigeonpea wilt resistance in breeding work.

376. PATHAK, P.D., and MAHESHWARI, D.K. 1973. Deterioration of seeds of Cajanus cajan Linn. by Aspergilli in storage. Balwant Vidyapeeth Journal of Agricultural and Scientific Research 15:97-100.

In a sample drawn from storage, about 60% of the seeds were found distorted and apparently in a state of decay. No work had been done in India on the storage of pigeonpea seeds. Mycoflora were therefore isolated and the effect of fungi on storage was investigated for 180 days. The survival of mycoflora on seeds in storage was also recorded.

377. PATHAK, P.D., SHARMA, O.P., and SHARMA, K.D. 1981. Effect of near-ultra violet irradiation on toxin production by certain fungi. Indian Phytopathology 34:525-527.

Studies with Aspergillus flavus, A. niger, A. terreus, Alternaria tenuis (A. alternata), and Penicillium chrysogenum, using pigeonpea seeds, are described. Mycelial growth and toxic metabolite production were adversely affected by near-UV irradiation in all except A. terreus.

378. PATIL, B.G., and SABLE, J.E. 1973. A note on the screening of tur against wilt disease. Punjabrao Krishi Vidyapeeth Research Journal 2:73-76.

The results of screening against F. oxysporum f.sp. udum over several years are discussed and some promising pigeonpea selections listed. They are:

Osmanabad, NP(WR) 19, NP-69, SI 03, Balapur-10, P-1005, Washim 4, Chandrikapur-1, Paras-5, and Jarud.

379. PATIL, B.G., and SAPKAL, R.C. 1981. Reaction of tur varieties to Phyllosticta leaf blight. Indian Journal of Mycology and Plant Pathology 11:117.

Of 91 pigeonpea cultivars, screened after inoculation with P. cajani, 19 were resistant and 46 moderately so. These are listed.

380. PATINO, G., and ZAUMEYER, W.J. 1959. A new strain of tobacco-streak virus from peas. Phytopathology 49:43-48.

A newly described strain of tobacco streak virus from peas produced yellow mottle symptoms in pigeonpea in greenhouse inoculation tests.

381. PAVGI, M.S., and SINGH, U.P. 1964. Parasitic fungi from northern India. III. Mycopathologia et Mycologia Applicata 24:347-354.

Colletotrichum cajani is listed on pigeonpea.

382. PAVGI, M.S., and SINGH, R.A. 1965. Some parasitic fungi on pigeonpea from India. Mycopathologia et Mycologia Applicata 27:97-106.

The eight fungi recorded include the new species Cercoseptoria cajanicola, Macrophoma cajanicola, and Pyrenochaeta cajani.

383. PAVGI, M.S., and SINGH, R.A. 1971. Parasitic fungi from North India. VIII. Mycopathologia et Mycologia Applicata 43:117-125.

Alternaria tenuissima (Fr.) Wiltshire is reported on pigeonpea.

384. PEARL, R.T. 1923. Report of the Mycologist to the Government of Central Provinces and Berar. Report of the Department of Agriculture, Central Provinces and Berar, 1921-22. pp. 19-20.

Wilt caused by F. udum is reported to be common in parts of Berar (Central India).

385. PEREZ, J.E., and CORTES-MONLLOR, A. 1970. A mosaic virus of cowpea from Puerto Rico. Plant Disease Reporter 54:212-216.

A virus transmitted by Cerotoma ruficornis was isolated from naturally-infected cowpeas (Vigna unguiculata) in Puerto Rico. In greenhouse inoculation tests the virus produced yellow mosaic symptoms in pigeonpeas. The virus belonged to the group of beetle-transmitted viruses, and closely resembled the Arkansas cowpea mosaic virus. The cowpea virus is a potential threat to pigeonpea in Puerto Rico.

386. PHELPS, R.H., OUDIT, I.L., and PAGE, C. 1974. Sclerotium blight, Sclerotium rolfsii, a new disease of pigeonpea, Cajanus cajan. Proceedings of the Caribbean Crop Protection Symposium on Horticultural Crops. pp. 63-70.

A new disease caused by S. rolfsii was observed affecting seedlings in dense plantings of pigeonpea in Trinidad. In greenhouse inoculation studies pigeonpea plants were susceptible up to 27 days after germination.

Resistance to infection was exhibited between 27 and 45 days and plants older than 45 days appeared to be immune. All determinate pigeonpea varieties tested were susceptible to infection by S. rolfsii, but there appears to be resistance in some semideterminate types.

387. PLYMEN, F.J. 1933. Report of the Department of Agriculture, Central Provinces, Nagpur, 1932-33. 40 pp.

In a series of inoculation experiments on 72 cultures of pigeonpea at Nagpur in 1931-32 with the wilt organism (F. vasinfectum), the incidence of infection ranged from 3 to 94%. Attention is now being concentrated on the development of resistant strains, i.e., those showing not more than 25% infection. Strain no. 3, having already given satisfactory results, has been released for multiplication and distribution.

388. PRASAD, M., and CHAUDHARY, S.K. 1965. Studies on the effects of carbon and nitrogen on macro-conidial, micro-conidial and chlamydospore production in Fusarium udum Butler. Proceedings of the National Academy of Sciences of India, Section B 35:171-181.

Maximum dry weight and maximum production of macro- and microconidia were obtained on a medium containing C and N (as sucrose and ammonium nitrate) at 3.368 and 0.03 g/1, respectively. Chalmydospore production was independent of the N concentration.

389. PRASAD, M., and CHAUDHARY, S.K. 1966. Studies on the effect of different phosphorus concentrations on the production of chlamydospores, micro-conidia and macro-conidia in the culture of Fusarium udum Butler. Proceedings of the National Academy of Sciences, India, Section B 36:43-48.

A concentration of 0.064% P in a liquid medium was optimum for mycelial growth and conidial formation of F. udum from pigeonpea, while chlamydospores were formed in abundance at only the lowest levels (0.002-0.004%).

390. PRASAD, M., and CHAUDHARY, S.K. 1967. Effect of sulphur on sporulation of Fusarium udum Butler. Journal of the Indian Botanical Society 46:45-51.

A concentration of 0.032% S (supplied as MgSO4) was optimum for mycelial growth and conidia formation of F. udum from pigeonpea, and 0.008-0.016% for chlamydospore formation. Growth and sporulation declined sharply above the level of the optimum concentrations.

391. PRASAD, M., and CHAUDHARY, S.K. 1973. Variations in amino acids and sugars and their effect on growth and sporulation in Fusarium oxysporum f. udum. Phytopathologische Zeitschrift 78:147-151.

Sugars and amino acids were analysed in mycelial extracts of cultures filtrates of Fusarium oxysporum f.sp. udum in relation to growth and spore formation. Sucrose is not assimitated as such and hydrolysis into glucose and fructose is essential to initiate formation of micro- and macroconidia initiation of glucose and fructose. It is slow at the beginning but increases with rapid growth of sporulation. Alanine glutamic acid, α-amino butyric acid and homo serine initiate formation of macro- and microconidia on the 2nd day. Arginine and nistidine stimulate chlamydospore formation on the

9th and 10th day. With the appearance of asparagine and cystine in the mycelial extract, the number of macroconidia decreases whereas mycelial growth and formation of other spore forms continues steadily. The appearance of glycine and serine corresponds to a rapid increase in mycelial weight. Larger numbers and amounts of amino acids were found in mycelial extracts than unculture filtrates.

392. PRASAD, M., and CHAUDHARY, S.K. 1974. In vitro production of fusaric acid and its impact on growth and sporulation in _Fusarium oxysporum_ f. _udum_. Phytopathologische Zeitschrift 80:279-282.

Isolates of _F. oxysporum_ f.sp. _udum_ from pigeonpea liberated fusaric acid during the rapid growth phase of the mycelium. The toxin was detected in both the mycelial extract and the cultural filtrate. Addition of Zn to the culture medium stimulated fusaric acid accumulation considerably and reduced the production of microconidia.

393. PRASAD, M., and CHAUDHARY, S.K. 1974. Amino acids and fusaric acid production in tissues of _Cajanus cajan_ infected with _Fusarium oxysporum_ f. _udum_ pathogenic fungi. Phytopathologische Zeitschrift 81:339-345.

In all pigeonpea varieties studied amino acids decreased after infection with _F. oxysporum_ f.sp. _udum_. Inoculated plants yielded fusaric acid from root and shoot extracts, the largest amount occurring in the most susceptible varieties -- early 269 and 348. Continued presence of leucine/isoleucine in diseased tissues may stimulate fusaric acid production.

394. PRASAD, M., and CHAUDHARY, S.K. 1975. Influence of vitamins on growth and sporulation of _Fusarium oxysporum_ f.sp. _udum_. Phytopathologische Zeitschrift 82:56-62.

Pyridoxine and riboflavin stimulated mycelial growth of _F. oxysporum_ f.sp. _udum_ (_F. udum_) but inhibited the formation of macro- and microconidia. Inositol, thiamine, and biotin had little effect on growth, stimulated microconidia and repressed macroconidia. All 10 vitamins tested stimulated chlamydospore production. Biotin increased the size of all spore forms, thiamine increased that of macroconidia, and inositol that of chlamydospores.

395. PRASAD, M., and CHAUDHARY, S.K. 1976. Influence of IAA and GA on mycelial output and sporulation of varied spore forms of _Fusarium oxysporum_ f.sp. _udum_. Indian Phytopathology 29:193-194.

The effect of different concentrations of indole acetic acid and gibberellic acid on mycelial growth, and the variation in populations and size of three spore forms of _F. oxysporum_ f.sp. _udum_ (_F. udum_), are described.

396. PRASAD, M., and CHAUDHARY, S.K. 1977. Relation of pH levels and varied nutrient media to growth and sporulation of _Fusarium oxysporum_ f. _udum_ (Butler) Sn. et H. Research Journal of Ranchi University 13:214-222.

In _F. oxysporum_ f.sp. _udum_ the best mycelial growth and sporulation of macro- and microconidia were recorded at a pH level of 6.0; chlamdydospores, however, sporulated best at pH 3.5 and least at pH 6.0. For macro- and microconidial sporulation, as well as for mycelial accumulation, the pH level of 6.5 had a positive adverse effect. With increasing age of the culture, the comparative performance of the different media varied. The best growth was in Rawlin's and Richard's media, and the sporulation of macro- and microconidia was best in potato-dextrose and Czapek's media, respectively.

397. PRASAD, M., and CHAUDHARY, S.K. 1977. Effect of different concentrations of Dl-isoleucine, Dl-valine, and Dl-alanine on growth and sporulation in Fusarium oxysporum f. udum (Butl.) Sn. et H. Zentralblatt fur Bakterialogie, Parasitenkunde, Infektions Krankheiten und Hygiene 132:735-739.

Added as extra N to the already-present inorganic source, DL-alanine and Dl-valine inhibited the growth of F. oxysporum f.sp. udum. Dl-valine stimulated microconidial formation in young cultures, and at the lowest concentration, depressed macroconidial sporulation in both young and old cultures. In old cultures the lowest concentration of valine stimulated chlamydospore differentiation rapidly, higher concentrations being less effective. Dl-alanine depressed both macro- and microconidial sporulation whereas Dl-isoleucine stimulated it. Specific doses of the three amino acids are needed when applied to already-present N sources. Mycelial growth and sporulation (all three spore forms) were also conditioned by the age of the culture.

398. PRASAD, N. 1978. Status of fusarial wilts. Indian Journal of Mycology and Plant Pathology 8:5-18.

The status of fusarial wilts of cumin, castor, linseed, cotton, lentil, pigeonpea, sesamum, coriander, and Eruca sativa in India is discussed in detail, with particular reference to the problems of variability in wilt-causing fusaria, host-pathogen interactions, and their remedial measures.

399. PRASAD, S.N. 1965. Studies on sterility disease of 'rahar' (Cajanus cajan). Allahabad Farmer 39:235-237.

Symptoms of the mosaic virus disease on small and chlorotic leaves and the suppression of the flowering are listed. First symptoms in late varieties appeared on the 10th day after the date of first flowering. All varieties were more or less susceptible to the disease. At harvesting time infection was 100% in medium-late varieties. Severely diseased branches did not form flower buds.

400. PRESTON, N.W. 1977. Cajanone: an antifungal isoflavanone from Cajanus cajan. Phytochemistry 16:144-145.

The antifungal compound, cajanone, is identified as the major compound of the roots of pigeonpea of which it comprises approximately 0.14% dry weight. Cajanone, isolated by thin-layer chromatography from a methanolic extract of dried and milled pigeonpea roots, totally inhibited germ-tube growth of F. oxysporum f.sp. udum, the pigeonpea wilt pathogen, at 50 ppm in vitro.

401. PURKAYASTHA, R.P., and DAS, A. 1973. Amino acids associated with pathogenicity of UV-induced mutants of Fusarium udum inciting wilt of pigeonpea. Proceedings of the Indian Science Congress 60:357. (Abstract.)

A virulent strain (FU 13) of F. udum was subjected to UV radiation. The

0.01% survival was most useful in producing the highest rate of mutation. Of the 400 surviving colonies studied, eight stable amino acid deficient mutants were isolated and characterized. Four of these mutants required methionine either singly or alternately while one mutant (M602) had three alternate deficiencies as methionine/cysteine/cystine. Growth responses of M602 and a methionine-required mutant (M602) were studied in vitro. The pathogenicities of M602 and M607 were tested on a susceptible variety of pigeonpea. It was observed that inocula, supplemented with optimal concentrations of the required amino acids, partially restored the pathogenicity of the test mutants that were otherwise nonpathogenic. Methionine, however, appeared to have an important role in pathogenesis.

402. PURKAYASTHA, R.P., and CHATTOPADHYAY, M. 1975. Antibiotic sensitivity of normal and amino-deficient mutants of Fusarium udum in relation to control of wilt disease of Cajanus cajan (L.) Millsp. Indian Journal of Experimental Biology 13:58-60.

Sensitivity of three UV-induced amino acid deficient mutants in F. udum and their parent strain (FU-13) to four antibiotics was tested in vitro. Aureofungin (100 μg/ml) most effectively inhibited spore germination, germ tube, and mycelial growth of the test strains. Pathogenicity tests on pigeonpea revealed that FU-13 and M802 were virulent and avirulent, respectively, while M602 and M607 were nonpathogenic. Selective toxicity of antibiotics to test strains was discussed in relation to the control of wilt disease of pigeonpea.

403. PURSEGLOVE, J.W. 1968. Tropical crops. Dicotyledons 1. London, UK: Longmans. p. 240.

Wilt caused by the soil-borne fungus F. udum is the most important disease of pigeonpea in India. Physalospora sp is the cause of a serious disease of pigeonpea, particularly those grown as a perennial. Similar diseases are caused by Diplodia cajani and Phoma sp.

404. QAIYUM, A. 1965. Studies on Phyllosticta leaf spot of arhar (Cajanus cajan). M.Sc. thesis, Agra University, India.

405. RACHIE, K.O., and WURSTER, R.T. 1971. The potential of pigeonpea (Cajanus cajan Millsp.) as a horticultural crop in East Africa. Acta Horticulturae 21:172-178.

In East Africa, pigeonpeas are attacked by relatively few diseases and pests. In pigeonpea germplasm trials at Kabanyolo, Uganda, a few diseases were observed to limit production. These were: basal stem canker (possibly Macrophomina sp), which causes death of affected plants; leaf spot (Cercospora sp) which reduces yields in susceptible lines and may cause early leaf-shedding, flower abortion, and/or poor pod development; powdery mildew (L. taurica), which may cause leaf-shedding; and bacterial leaf spots that are most serious during the rainy season.

406. RACHIE, K.O., and ROBERTS, L.M. 1974. Grain legumes of the lowland tropics. Advances in Agronomy 26:1-132.

In the lowland tropics pigeonpea appears to be more resistant to different diseases than many other food legumes. Important diseases affecting pigeonpeas in different regions of the world are listed. Practical approaches to disease control are through resistant varieties, cultural practices, and seed treatments. Fungicidal seed dressings are often used to control seedling diseases.

407. RAMAKRISHNAN, K., and KANDASWAMY, T.K. 1972. Investigations on virus diseases of pulse crops in Tamil Nadu: final technical report. Coimbatore, Tamil Nadu, India: Tamil Nadu Agricultural University. 53 pp.

A survey was made throughout the state of Tamil Nadu to find out the prevalence and extent of infection of sterility mosaic disease. A total of 1246 holdings, covering an area of 9142 ha of pigeonpea, were surveyed. The percentage of incidence, with mild or severe forms of the disease, ranged from stray to 30. In a few places the incidence was 75-100%. The symptomatology of the disease was also studied in detail. Studies of transmission had shown that an eriophyid mite, Aceria cajani, which does not seem to have other host plants was the transmitting agent of the disease. The varieties NP(WR)-15, P-4835, P-1778, P-1289, P-1100, and P-2621 showed only mild reaction and less than 3% incidence.

408. RAMAKRISHNAN, T.S., and SUNDARAM, N.V. 1955. Notes on some fungi from south India. IV. Indian Phytopathology 7:140-151.

Woroninella umbilicata (Synchytrium umbilicatum) is recorded on pigeonpea.

409. RAMPERSAD, M. 1976. Determination of uredospore germination in pigeonpea. Applied Botany Study Project, University of West Indies, St. Augustine, Trinidad, Trinidad and Tobago.

An in vivo technique for observing uredospore germination (Uredo cajani) has been developed. This showed that uredospores penetrated the leaf within 8 h after inoculation.

410. RANGEL, E. 1915. [Fungus parasites of pigeonpea (Cajanus indicus Spreng.)] (In Pt.) Boletim de Agricultura Sao Paulo 16:145-156.

A detailed description is given of several newly-identified fungus pathogens of pigeonpea in Brazil. These are Cercospora instabilis, Colletotrichum cajani, Phoma cajani, Phyllosticta cajani, and Vellosiella cajani.

411. RANGEL, E. 1916. Fungus parasities of pigeonpea (Cajanus indicus Spreng. (In Pt.). Lavoura 18:5-12.

See 410: the same paper.

412. RAO, V.G. 1964. The genus Phyllosticta in Bombay, Maharashtra. IV. Mycopathologia 22:157-166.

New species for the state of Maharashtra include Phyllosticta cajani on pigeonpea.

413. RATHI, Y.P.S., and NENE, Y.L. 1976. Influence of different host combinations on virus-vector relation of mung bean yellow mosaic virus. Pantnagar Journal of Research 1:107-111.

The influence of different source-test combinations in the virus-vector relationship of mung bean yellow mosaic virus (MYMV) was studied. The minimum acquisition and inoculation periods required for whitefly adults (Bemisia tabaci) to become infective varied from 15 to >60 min and 10 to >60 min, respectively. The adults require longer acquisition and inoculation periods to infect Bragg soybean and T-21 pigeonpea than to infect black gram and mung bean.

414. RATHI, Y.P.S., and LAL, S. 1977. Wilt disease of pigeonpea caused by Macrophomina phaseoli. Acta Botanica Indica 5:83-84.

415. RATHI, Y.P.S. 1979. Temik treatment of pigeonpea seeds for prevention of sterility mosaic. Acta Botanica Indica 7:90-91.

Plants from seed treated with Temik 10G (10% aldicarb), a granular systemic pesticide, and inoculated at weekly intervals for 8 weeks did not exhibit symptoms of pigeonpea sterility mosaic virus until maturity.

416. RAUT, N.K., and BHOMBE, B.B. 1971. A review of the work of selection of tur varieties resistant to Fusarium wilt at College of Agriculture, Parbhani (MS). Magazine, College of Agriculture, Parbhani 12:37-42.

Twelve selections (Seven Bori-11 selections, Tuljapur 455, Latur 466-I, Latur-476-II, DT-230, and M4 x K-132) showed considerable resistance to the wilt.

417. RAVISHANKER. 1936. Isolation of wilt-resistant tur. Nagpur Agricultural College Magazine 10:162-167.

The isolated CP (Central Provinces) types of pigeonpea were tested for wilt resistance continuously for 4 years in a wilt-infected area. EB-38, a strain from CP type 9, was found to possess the greatest resistance to the disease. The yield potential of EB-38 was compared with the standard varieties EB-2 and EB-3. EB-38 was found to be almost as good a yielder as these two varieties. The wilt-resistant Pusa types are not suitable for the conditions of this Province. EB-38 is recommended for locations where wilt is endemic, and EB-3 for wilt-free areas.

418. RAYCHAUDHURI, S.P. 1941. Studies on the canker disease of pigeonpea (Cajanus cajan [L.] Millsp.) caused by Diplodia cajani nov. sp. Thesis, Indian Agricultural Research Institute, New Delhi, India.

419. RAYCHAUDHURI, S.P. 1942. A disease of pigeonpea (Cajanus cajan [L.] Millsp.) caused by Diplodia cajani spec. nov. Indian Journal of Agricultural Sciences 12:837-847.

A species of Diplodia, apparently distinct from any hitherto described, was isolated from cankered pigeonpea plants of the 1939 and 1940 crops received from the Imperial Agricultural Research Institute, Pusa, and is named D. cajani n.sp. The fungus is characterized by an olive-green to brown mycelium (black in the mass), 2.6-8.6 (average 4.3) μ in diameter; globose, ostiolate, erumpent pycnidia, 301-464 (405) μ in diameter; and bicellular, ovate, sometimes ovoid to ellipsoid conidia, 21.5-30.1 by 10.8-12.9 (25.1 by 12.7) μ, attached by the narrower end to short needle-shaped, pale to dark brown conidiophores. The upper cell of the conidium invariably germinates first, producing a germ tube in 5 h, while a period of 15-20 h is required by the lower cell for the same process.

The primary symptoms of the disease are thickening and distortion of the collar region, developing after 20-30 days into large, deep-seated cankers, which usually spread and girdle the stem, causing the collapse of the plant (though partial recovery through callus formation occasionally takes place). The cankered portion of the stem is often twisted, owing to the unequal development of the wood, and in advanced stages of infection the internal tissues, a few centimeters above the lesion, are discolored; at this site adventitious roots are produced. Microscopic examination of the slate-blue tissues (likewise a feature of the similar diseases of pigeonpea described by Leach and Wright from Trinidad) revealed the presence of mycelium in the primary and secondary xylem vessels.

Positive results were obtained in inoculation experiments with pure cultures of four isolates of _D. cajani_ on wounded and unwounded plants, the severity of the symptoms being greatly increased by previous injury to the collar.

The minimum, optimum, and maximum temperatures for the growth of the fungus on potato dextrose agar (the best of the media tested) were below 20, 30, and above 35° C, respectively.

420. RAYCHAUDHURI, S.P. 1947. Further studies on _Diplodia cajani_ Raychaudhuri. Journal of the Indian Botanical Society 26:221-225.

Growth and culture of several strains of _Diplodia cajani_ from cankered pigeonpea are described.

421. RAYCHAUDHURI, S.P. 1968. Diseases of pulses pose a challenge to plant pathologists, breeders. Indian Farming 17:39-43.

Varieties resistant to pigeonpea wilt include NPWR-15, -16, and -42.

422. REDDY, M.V., and NENE, Y.L. 1979. Ringspot symptom: a genotypic expression of pigeonpea sterility mosaic. Tropical Grain Legume Bulletin 15:27-29.

The sterility mosaic manifests itself through ring-spot symptoms in certain genotypes. The ring-spot symptom is considered to be a tolerant reaction because such genotypes showed apparently normal flowering and podding in spite of infection.

423. REDDY, M.V., and NENE, Y.L. 1980. Influence of sterility mosaic resistant pigeonpeas on multiplication of the mite vector. Indian Phytopathology 33:61-63.

Pigeonpea lines resistant to the causal agent of sterility mosaic did not permit continued multiplication of its eriophyid mite vector _Aceria cajani_. Resistance to the causal agent and lack of continued multiplication of the mite vector on these lines are expected to provide greater stability of resistance to the disease.

424. REDDY, M.V., and NENE, Y.L. 1981. Some aspects of field screening of pigeonpea for resistance to sterility mosaic disease. Pages 285-289 _in_

Proceedings of the International Workshop on Pigeonpeas, 15-19 Dec 1980, ICRISAT Center, India. v.2. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

The "infector row" or "spreader row" system was found to be very effective for large-scale field screenings of pigeonpea for resistance to sterility mosaic. The system consists of advance planting of a susceptible cultivar at frequent intervals in the field or at one edge of the field and artificially inoculating it through a leaf stapling technique. Test materials are planted at the normal sowing time, with disease indicator rows. Plants not showing infection 30 days after planting are inoculated by the "leaf-stapling" technique. When disease development is delayed, plants not showing symptoms are topped, and the fresh regrowth is examined for symptoms. Early observations, 30-45 days after planting, are essential to properly detect the mild mosaic and ring-spot reactions, as these might get masked with age in certain genotypes.

425. REDDY, M.V., and NENE, Y.L. 1981. Estimation of yield loss in pigeonpea due to sterility mosaic. Pages 305-312 in Proceedings of the International Workshop on Pigeonpeas, 15-19 Dec 1980, ICRISAT Center, India. v.2. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

The effect of sterility mosaic on yield and yield components of the early-, medium- and late-maturing cultivars of pigeonpea was studied in both field and pot trials. In a field trial in 1975-76, the effect of the disease on yield and yield components of a medium-maturity susceptible cultivar (ICP-1), when infected at different ages, was analyzed. The incubation period was found to be longer in older plants. Infections up to 45 days mostly resulted in complete sterility, but susceptibility of the plant was found to decrease with age. Early infections caused considerable increase in the number of secondary branches, prolonged the duration of the crop, and caused yield loss to the extent of 95%. The loss decreased with the increase in age at infection. Similar results were obtained when the experiment was repeated in the 1977-78 season. An increase in the number of tertiary branches was also found in plants infected early. In a pot trial with cv T-21, an early-maturing cultivar, similar results were obtained. The reduction in yields of a late-maturing cultivar, NP(WR)-15, which shows mild mosaic symptoms, was less.

426. (Deleted.)

427. REDDY, M.V., NENE, Y.L., and KANNAIYAN, J. 1981. Identification and utilization of multiple disease resistance in pigeonpea. Pages 83-85 in Proceedings of the FAI Group Discussion on Increasing Pulse and Oilseed Production in India, 4-5 Sept 1980, New Delhi, India. New Delhi, India: Fertilizer Association of India.

Sources of resistance to wilt, sterility mosaic, and *Phytophthora* blight, individually as well as in various combinations, are reported.

428. RIZWI, M.A. 1978. A new leaf spot disease of pigeonpea. Indian Phytopathology 31:235.

Cladosporium cladosporioides (Fr.) de Vr. caused a severe leaf spot of pigeonpea in Bhagalpur (Bihar) during the 1975-76 season. The disease is characterized by grayish, circular spots surrounded by a yellow halo zone.

429. RODRIGUEZ-KABANA, R., and INGRAM, E.G. 1978. Susceptibility of pigeonpeas to plant parasitic nematodes in Alabama. Nematropica 8:32-34.

In greenhouse studies, roots of pigeonpeas grown in soil from a soybean field contained Hoplolaimus galeatus, Pratylenchus brachyurus, and Tylenchorhynchus claytoni. In soil from a cotton field, the roots contained Helicotylenchus dihystera and P. schribneri. Pigeonpea roots were severely attacked by Meloidogyne arenaria in soil from a groundnut field. Results indicate that pigeonpeas may not be suitable to use in rotation schemes in the southeastern United States.

430. ROHEWAL, S.S., JOSHI, B.C., and SINGH, S.P. 1966. Arhar S-103 an erect type yielding high. Indian Farming 16:31.

S-103 is a tall and erect variety of pigeonpea with profuse pod formation. The seeds are large and brown and the plants are highly tolerant of F. udum.

431. ROMAN, J. 1964. Immunity of sugarcane to the reniform nematode. Journal of Agriculture of the University of Puerto Rico 48:162-163.

Field soil from Puerto Rico, naturally infested with the reniform nematode Rotylenchulus reniformis, was planted to several crops, including pigeonpea, in the greenhouse. After 1 year only pigeonpeas and marigolds increased R. reniformis to high numbers, with pigeonpeas producing the highest population.

432. ROY, T.C. 1949. I. Studies on the soil microorganisms with special reference to their antibiotic effect on Fusarium udum Butler, the wilt organism of arhar (Cajanus cajan [Linn.] Millsp.). II. Some aspects of cultural variation and taxonomic considerations of F. udum Butl., the causal organism of wilt of pigeonpea. Thesis, Indian Agricultural Research Institute, New Delhi, India. 62 pp.

433. RUBAIHAYO, P.R., and ONIM, J.F.M. 1975. A study of some characters of pigeonpea. SABRAO Journal 7:183-187.

There were significant differences in the incidence of a leaf-spot disease caused by Mycovellosiella cajani at five locations in Uganda. Only at Kabanyolo, which has a wet and humid climate during the pigeonpea-growing season, was there a significant correlation between grain yield and disease incidence. At the other locations, which have a dry climate, pigeonpea grain yields and disease incidence were not significantly correlated. This indicates that the disease is not a major factor limiting grain yields in dry areas.

434. SABET, K.A. 1959. Studies in the bacterial diseases of Sudan Crops. III. On the occurrence, host range and taxonomy of bacteria causing leaf blight diseases of certain leguminous plants. Annals of Applied Biology 47:318-331.

A comparative study of several strains of X. phaseoli bacteria and one strain each of X. phaseoli var fuscans (host unknown), X. cajani from pigeonpea, and X. tamarindi from Tamarindus indica showed they were all indistinguishable by the usual bacteriological procedures. Cross inoculations did not overlap the host ranges in the case of X. cajani. Usually infection appeared initially as minute, dark green, rather water-soaked spots which generally developed on all parts. The systemic position of pathogens was reconsidered and all except X. phaseoli var fuscans were proposed as special forms of X. phaseoli: X. phaseoli formae speciales vignicola alfalfae, cajani, and tamarindi.

435. SABET, K.A., ISHAG, F., and KHALIL, O. 1969. Studies on the bacterial diseases of Sudan crops. VII. New records. Annals of Applied Biology 63:357-369.

At the University of Khartoum bacterial diseases of the weeds Heliotropium sudanicum, Rhyncosia memnonia, Vigna radiata, V. pubigera, Euphorbia acalyphoides and Phyllanthus niruri were recorded for the first time and Xanthomonas phaseoli f.sp. cajani was also recorded on pigeonpea for the first time in Sudan. The nomenclature of X. spp on these hosts is discussed from two points of view, considering the pathogens as (a) all f.sp. of X. campestris or (b) of X. phaseoli (on Leguminosae) and X. ricini (on Euphorbiaceae). A new species, X. heliotropii, is proposed for the H. sudanicum pathogen. It was apparent that bacterial strains on many weed plants can infect cultivated crops.

436. SADASIVAN, T.S., and SUBRAMANIAN, C.V. 1954. Recent advances in the study of soil-borne Fusaria. Journal of the Indian Botanical Society 33:162-176.

Research on tropical cultivated soils in relation to soil-borne fusarioses, which include F. udum, the causal agent of pigeonpea wilt, is summarized.

437. SAKSENA, H.K., SINGH, S.B., and KUMAR, K. 1970. Leaf spot and blight diseases of arhar caused by Rhizoctonia. Pages 241-247 in Recent advances in crop production: proceedings of the Symposium, Feb 1970, U.P. Institute of Agricultural Sciences, Kanpur, India. Kanpur, U.P., India: Uttar Pradesh Institute of Agricultural Sciences.

Two new leaf diseases of pigeonpea, incited by R. solani Kuhn and R. bataticola (Taub.) Butl. (Macrophomina phaseoli [Maubl.] Ashby), are reported and described. Both the pathogens penetrated the leaves through stomatal openings without the formation of any infection structure. Plants 45-75 days old were most susceptible to attack by R. solani and 30- to 60-day-old plants to R. bataticola. Brassicol, vapam, Ceresan/wet and captan completely inhibited the growth of both the species of Rhizoctonia in culture.

438. SAKSENA, H.K., and KUMAR, K. 1971. Some aspects of epidemiology and control of Phyllosticta leaf spot of arhar (Cajanus cajan [L.] Millsp.). Proceedings of the Indian National Science Academy 37:399-406.

Leaf spot of pigeonpea caused by P. cajani has been found to occur in increasing proportions throughout Uttar Pradesh in the late 1960s. The disease appears in July and persists throughout the cropping season. Two years' data on disease incidence in fields have shown the percentage of disease intensity to vary from 4.3 to 31.8. The disease intensity was high (21.3-31.8%) during the period of July to October in the mean temperature range of 26-30°C and the mean relative humidity range of 73-89%. The maximum disease intensity of 31.8% was observed in August, after which it gradually declined reaching its lowest during the cool months of December and January.

The leaves were susceptible to infection from 12 to 57 days after emergence under greenhouse conditions, with maximum susceptibility when the plants are about 1.5 months old.

The pathogen survived in the infective stage for more than 15 months in diseased plant-refuse in soil which serves as the primary source of inoculum. The secondary spread of the disease was by spores produced in pycnidia on leaf spots. Spores germinated in 6-8 h and penetration of leaves occurred through stomata and intact surfaces by means of an infection peg produced from the appressorium.

Out of 139 pigeonpea varieties screened, variety 3/23-36/1 alone was resistant. Bisdithane, Dithane Z-78, captan, Miltox, and Cuman were effective (in that order) in checking the secondary spread of the disease.

439. SAKSENA, H.K., SINGH, U.N., and SINGH, R.R. 1976. Mycosphaerella from a leaf spot of arhar (Cajanus cajan [L.] Millsp.). Indian Journal of Farm Sciences 4:124-125.

On the basis of morphological characters, the fungus is identified as a species of Mycosphaerella. This appears to be the first record of Mycosphaerella on pigeonpea from any part of the world. This species has been reported as the perfect state of species of imperfect genera such as Phyllosticta and Cercospora.

440. SAMAJPATI, J. 1973. Interaction of near-ultraviolet radiation and hydrogen-ion concentration on growth and sporulation of Fusarium udum Butl. Science and Culture 39:127-129.

At pH 5.0, NUV irradiation can effectively induce either vegetative growth or sporulation. At pH 3.5-4.5 and 8.0 there was no sporulation either in the dark or under NUV irradiation but, at pH 4.5 and 7.5, there was a sporulation under NUV irradiation. A treatment of NUV irradiation and pH, or the interaction of both on the growth and sporulation of the test-fungus, was studied.

441. SAROJINI, T.S. 1946. Soil conditions and root diseases, with special reference to Fusarium udum on red gram. Ph.D. thesis, University of Madras, Madras, Tamil Nadu, India.

442. SAROJINI, T.S., and YOGESWARI, L. 1947. Aeration affecting growth and sporulation of some Fusaria in liquid cultures. Proceedings of the Indian Academy of Sciences, Section B 26:69-76.

The effect of aseptic aeration on the growth and sporulation of three soil fungi--F. vasinfectum, F. moniliforme, and F. udum--was studied in detail. Sporulation of all three was optimum at 0.2% nitrate nitrogen in standard Horne and Mitters' liquid medium. Aeration stimulated mycelial growth (on both dry and ash-weight bases) but it inhibited sporulation (quantitatively determined). Aeration had no direct effect on the pH of the culture medium. Sporulation decreased with increasing hours of aeration.

443. SAROJINI, T.S. 1950. Soil conditions and root diseases. I. Micro-nutrient

elements and disease development of F. udum on red gram. Journal of the Madras University, Section B 19:1-32.

The addition of micronutrient elements -- Bo, Mn, and Zn (at 20, 40, and 80 ppm) -- to wilt-infested soils resulted in greater protection of seedling emergence and, additionally, promoted plant growth. Zn retarded the colonization of Fusaria on the host more than did Bo and Mn. Survival and persistence of F. udum was limited by the presence of micronutrients in the soil. Zn hastened the disappearance of the fungus more than Bo and Mn.

444. SAROJINI, T.S. 1951. Soil conditions and root diseases. II. Fusarium udum disease of red gram (Cajanus cajan [Linn.] Millsp.). Proceedings of the Indian Academy of Sciences, Section B 33:49-68.

Seven strains of Fusarium udum were isolated from infected plants at Coimbatore, India. These were numbered I to VII. Strains V and VI caused damping off. Strains I, II, and III were more virulent than others. The colonization of Fusarium on host stubble buried in infested soil was temporarily retarded by the addition to the soil of micronutrients, particularly zinc. After 4 months there was no colonization with 20, 40, and 80 ppm Zn compared with 100% in the control. The survival of F. udum on infested stubble in the soil was reduced by the addition of micronutrients (Bo, Zn, Mn), the fungus being exterminated by Zn within 4-6 weeks.

445. SAROJINI, T.S. 1954. Soil conditions and root diseases. XI. Neocosmospora vasinfecta Smith disease of Cajanus cajan. Journal of the Madras University, Section B 24:137-142.

Neocosmospora vasinfecta was isolated from the roots of wilted pigeonpeas in an experimental plot at the University of Madras. Conidial and chalmydospore isolates were found to be more virulent to pigeonpea than the original strain, its ascospore derivatives, or F. udum. The symptoms were similar to those caused by F. udum. Seedling infection at the first leaf stage was indicated by the preliminary curling of leaf tips, while in older seedlings gradual yellowing of the leaflets was followed by wilting and collapse of the plant. Infection ranged from 63 to 100%. Microscopic examination of the diseased portions of the hypocotyl, and roots of plants infected with the ascogenous strain, showed numerous perithecia, while the other series yielded asexual spore forms in large numbers. It is concluded that N. vasinfecta should be classed with the "soil inhabiting" group of facultative saprophytes, like certain Fusarium spp, being capable of a parasitic existence when the occasion arises. It has been found in many arable and forest soils examined in the University laboratory.

446. SATYANARAYANA, G., and KALYANASUNDARAM, R. 1952. Soil conditions and root diseases. V. Symptomatology of wilted cotton and red gram. Proceedings of the Indian Academy of Sciences, Section B 36:54-58.

Symptoms of pigeonpea wilt did not culminate in vein-clearing as in cotton, although there was a general and well-marked dechlorophyllation, indicating a toxaemic condition. The in vitro changes in host physiology of cotton and pigeonpea were similar, despite the fact that the two pathogens have a great deal of host specificity and do not appear to have collateral hosts.

447. SEN GUPTA, P.K. 1963. Studies on some species of Fusarium inciting wilt

disease of pulses in West Bengal. Ph.D. thesis, University of Calcutta, Calcutta, West Bengal, India. 160 pp.

448. SEN GUPTA, P.K. 1974. Plant pathogenic species of the genus *Fusarium* in India. Nova Hedwigia 25:699-717.

Although symptoms produced by different species of *Fusarium* are mostly wilt and rots, other symptoms such as dieback, twig blight, leaf spots, etc., may also be produced in some cases. The same type of disease symptoms may be produced on a host by different species of *Fusarium* in different parts of India. Different symptoms may also be produced on the same host by the same species of *Fusarium* in different parts of India. *Fusarium oxysporum* f.sp. *udum*, the causal organism of pigeonpea wilt, is mentioned in the author's list of plant pathogenic species of *Fusarium* with their hosts and a description of the diseases they produce.

449. SEN GUPTA, P.K. 1974. Diseases of major pulse crops in India. PANS 20:409-415.

The diseases of pigeonpea, with particular reference to wilt and sterility mosaic, are described. A leaf spot caused by *Cercospora indica* Singh, a stem canker caused by *Diplodia cajani* Raychaudhari, and a bacterial leaf spot and stem canker caused by *X. cajani* Kulkarni et al. are reported.

450. SETH, M.L. 1962. Transmission of pigeonpea sterility by an eriophyid mite. Indian Phytopathology 15:225-227.

Eriophyid mites from diseased pigeonpea plants, when transferred, produced typical symptoms on healthy plants.

451. SETH, M.L. 1965. Further observations and studies on pigeonpea sterility. Indian Phytopathology 18:317-319.

The virus and its vector *Aceria cajani* appear to have no other host, so removal of old and volunteer plants might control the disease.

452. SHARIFF, M.H. 1973. Studies on the mycoflora associated with the seed of wheat, paddy, pigeonpea and Bengal gram from three different storage conditions. M.Sc. thesis, University of Allahabad, Allahabad, Uttar Pradesh, India.

453. SHARMA, H.C. 1963. Growth and sporulation of *Fusarium udum* in relation to C/N ratio and nitrogen sources. Physiologia Plantarum 16:276-280.

The results of a study on the effect of C:N ratio on growth and sporulation of *F. udum* are presented and discussed. The fungus was able to utilize nitrate, ammoniacal, and organic nitrogen. The source of N used appeared to be a more important factor affecting the growth and sporulation of the fungus than the C:N ratio. Potassium nitrate and asparagine were found to be the best sources for growth and sporulation among those tried. The drift in pH was also governed more by the source of nitrogen than the C:N ratio of the medium. The pH shift was towards the acid side when ammoniacal sources of nitrogen were used. The extent of growth and sporulation varied with the level of N in the medium.

454. SHARMA, M.C. 1965. Soil micro-fungi in relation to certain edaphic factors and arhar and cowpea crops. Proceedings of the Indian Science Congress 52:323. (Abstract.)

Soil conditions of a particular crop and its microflora have been shown to be influenced by surface vegetation. This study compares the influence of pigeonpea and cowpea (V. sinensis) on the microfungi and conditions of the soils on which they are grown. Soil samples from the 0-7.5 cm, 7.5-15 cm, and 15-21.5 cm horizons were analyzed. It was found that the fungal population in soils under pigeonpea is higher than in those under cowpea. Also, more species of fungi were found in soils under pigeonpea (53) than under cowpea, the moniliales and phycomycetes being the most prevalent. In all, 58 fungi were isolated, out of which 26 were common to both areas, 26 restricted to pigeonpea soils, and 5 confined to cowpea soils. It was presumed that the soil microflora in this case are more influenced by the surface cover than by the edaphic factors. The differences may also be due to the nature of their root exudates and hence the rhizosphere effect.

455. SHARMA, N.D., JOSHI, L.K., and VYAS, S.C. 1977. A new stem inoculation technique for testing Fusarium wilt of pigeonpea. Indian Phytopathology 30:406-407.

The plants were inoculated 45, 75, and 127 days after planting by giving a longitudinal cut on the stem with a sharp scalpel, 10-15 cm above ground level. The inoculum, consisting of mycelium and spores, was introduced in the cut portion. An absorbent cotton swab was wrapped around the inoculated portion to avoid desiccation and then wrapped with polyethylene strip. Wilting symptoms appeared 1 month after inoculation.

456. SHARMA, N.D., and MISHRA, R.P. 1977. Some additions to fungi of India. II. Journal of the Indian Botanical Society 56:130-141.

Twelve fungi belonging to the form class Deuteromycetes are described from Jabalpur forests. These include Cercospora thirumalacharri n.sp. on pigeonpea, described as follows: leaf spot extensive, often entire lower leaf surface is covered, bound by the veins; conidiophores abundant, hypophyllous, rarely amphigenous, stroma when present small blackish brown, fasciculate or single; conidiophores olivaceous brown with paler tip, uniform in color, multiseptate, unbranched, variously curved, geniculate with prominent scar of attachment to conidia, up to 16 septate, tip subtruncate, mostly uniform in width except at the geniculations, up to 375 μ long and 3-6.5 μ wide; conidia hyaline, broader below tapering upwards, straight or curved, distinctly septate, 3-26 septa, prominent scar at the base, base truncate or subtruncate, apex acute, 33-275 x 2.2-3.3 μ. The species differs from other Cercospora species in that C. instabilis Rangel, C. cajani P. Hennings, and C. indica Singh, described on Cajanus, have dense, unbranched, very long conidiophores with distinct scars and longer, hyaline, distinctly multiseptate conidia. It is therefore described as a new species.

457. SHARMA, N.K., and SETHI, C.L. 1975. Leghaemoglobin content of cowpea nodules as influenced by Meloidogyne incognita and Heterodera cajani. Indian Journal of Nematology 45:113-114.

The data given indicate that the nematodes interfered with the leghaemoglobin content of the cowpea root nodules, and that M. incognita caused more reduction than H. cajani.

458. SHARMA, R.P.R. 1980. Red gram breaks the rule. Seeds and Farms 6:29-30.

Pigeonpeas grown in the postrainy season suffer less from diseases, such as wilt and sterility mosaic, than do rainy-season pigeonpeas.

459. SHAW, F.J.F., and KASHI RAM. 1934. Improved varieties of crops produced at Pusa. Agriculture and Livestock in India 4:465-480.

Eighty-six types of pigeonpea were isolated at (old) Pusa, India, and tested for yielding ability and resistance to wilt disease. Seven promising types were released for distribution. Of these seven, yielding 1300 to 1900 kg/ha, three (types 15, 16, and 51) were erect late types, and the rest (types 24, 64, 80 and 82) were spreading and late. Types 16, 51, and 80 were wilt-resistant.

460. SHAW, F.J.F. 1936. Studies in Indian pulses: the inheritance of morphological characters and of wilt resistance in rahar (Cajanus indicus Spreng.). Indian Journal of Agricultural Sciences 6:139-187.

In a cross between two varieties of pigeonpea (Pusa types T-5 and T-80) inheritance of flower color followed a 9:3:3:1 ratio, the F1 and the double recessive being new phenotypes unlike either parent. Erect habit was partially dominant over the spreading; short stature was dominant over the tall; crowded habit of inflorescence was dominant over the open; brown seed of T-80 was dominant over the silver white of T-5, each in a 3:1 ratio. F2 and F3 populations were grown in infected fields and the loss due to wilt in F2 suggests that the inheritance of resistance may be found in a 9:7 or 27:37 ratio, resistance being dominant. Ratios of the various phenotypes were not disturbed by the incidence of the disease, showing that the inheritance of resistance was not linked with that of any of the morphological characters studied.

461. SHELDRAKE, A.R., NARAYANAN, A., and KANNAIYAN, J. 1978. Some effects of the physiological state of pigeonpeas on the incidence of the wilt disease. Tropical Grain Legume Bulletin 11-12:24-25.

Removal of flowers, and allowing the vegetative growth to continue, reduces wilt incidence. On the other hand defoliation during the reproductive phase increases the wilt. Defoliation in the ratooned crop also aggravates wilt incidence.

462. SHERIFF, N.M., KHAN, W.M.A., and ANNAPPAN, R.S. 1977. Red gram CO.3--an economic mutant strain for Tamil Nadu. Madras Agricultural Journal 64:561-564.

Mutation breeding research in pigeonpea has resulted in the development of a high-yielding mutant S-18 (CO.3) suitable for cultivation under both rainfed and irrigated conditions. Its duration is 130 days. On an average it records 1300 kg/ha and 1200 kg/ha under irrigated and rainfed conditions, or 9.8 and 9.1 kg/ha/day, respectively. A special advantage of CO.3 is its resistance to root rot and tolerance of wilt and pod borers.

463. SHERIFF, N.M., KHAN, W.M.A., and IYEMPERUMAL, S. 1977. A note on the study of

red gram mutants for resistance to root-rot disease under field conditions. Madras Agricultural Journal 64:691.

A mutant (S18), obtained by treating the pigeonpea cv CO.1 with 0.6% ethylmethane sulfonate showed resistance to root rot [(*F. udum* and *R. bataticola* (*Macrophomina phaseolina*)] under field conditions. The mean incidence of root rot in the mutant was 3.9%, compared with 32.3% in CO.1.

464. SHIT, S.K. 1976. Studies on variability in *Fusarium oxysporum* f.sp. *udum*, the incitant of wilt of pigeonpea. M.Sc. thesis, Bidhan Chandra Krishi Vishwa Vidyalaya, Kalyani, West Bengal, India. 57 pp.

465. SHIT, S.K., and SEN GUPTA, P.K. 1978. Possible existence of physiological races of *Fusarium oxysporum* f.sp. *udum*, the incitant of the wilt of pigeonpea. Indian Journal of Agricultural Sciences 48:629-632.

Seven isolates of *F. oxysporum* f.sp. *udum* (Butler) Snyd. & Hans., obtained from different parts of India, were studied for their cultural characters and pathogenicity. When grown on four different cultural media, the isolates showed variations in cultural characters, such as the amount of aerial mycelium and the texture. They also differed in their ability to sporulate. Their pathogenicity on four varieties of pigeonpea also differed. The isolates producing scanty mycelium in media were more pathogenic. No correlation could be found between the intensity of sporulation and pathogenicty. The existence of physiologic races of *F. oxysporum* f.sp. *udum* is suggested on the basis of pathogenic behavior.

466. SHIT, S.K., and SEN GUPTA, P.K. 1980. Pathogenic and enzymic variations in *Fusarium oxysporum* f.sp. *udum*. Indian Journal of Microbiology 20:46-48.

An assay of pectic and cellulolytic enzymes in the culture filtrates of the isolates of *F. oxysporum* f.sp. *udum* demonstrated the production of these enzymes by all the isolates. There was not much difference among the different isolates in pectin methyl esterase activity.

467. SHUKLA, D.N., and BHARGAVA, S.N. 1976. Fungi isolated from seeds of pulses. Proceedings of the National Academy of Sciences of India, Section B 46:453-455.

Aspergillus flavus, *A. niger*, *F. equiseti*, *Macrophomina phaseolina*, and *Phyllosticta* sp were isolated from untreated pigeonpea seeds, and *Fusarium* spp and *F. equiseti* from surface-sterilized seeds.

468. SHUKLA, D.N., and BHARGAVA, S.N. 1976. Some pathogenic fungi from pulses and oil seed crops. Proceedings of the National Academy of Sciences of India, Section B 46:531-532.

The *Fusarium* sp causing wilt, and *Aspergillus flavus* Lind. causing seedling rotting, were isolated from pigeonpea seeds.

469. SHUKLA, D.N., and BHARGAVA, S.N. 1978. Seed and seedling-rot of arhar. Proceedings of the National Academy of Sciences of India, Section B 48:167.

From among three *Aspergillus* spp isolated from pigeonpea seed, *A. flavus* proved to be pathogenic.

470. SHUKLA, D.S. 1975. Incidence of *Fusarium* wilt of pigeonpea in relation to soil composition. Indian Phytopathology 28:395-396.

In a pot experiment the wilt was lowest in heavy black soil (18.18%) and highest in sand alone (93.75%). The disease increased with the decrease of the proportion of soil in soil-sand mixture.

471. SIDERIS, C.P. 1929. Pythiaceous root parasities of various agricultural plants. Phytopathology 19:1140.

Pigeonpea was susceptible to most *Pythium* spp isolated from various crops.

472. SIDERIS, C.P. 1932. Taxonomic studies in the family Pythiaceae. II. Pythium. Mycologia 24:14-61.

Pythium splendens var *hawaiianum* n. var, a very aggressive parasite of pineapple roots, is moderately parasitic on those of the pigeonpea and several other plant species in Hawaii.

473. (Deleted.)

474. SINGH, A.B., and PANDEY, P.K. 1979. A new strain of tobacco mosaic virus causing mosaic disease in pigeonpea. Current Science 48:261.

Pigeonpea mosaic virus was identified as a strain of tobacco mosaic virus on the basis of sap transmission, physical properties in extracts, host range, and serology.

475. SINGH, A.P., and BHARGAVA, S.N. 1981. Survival studies on three species of *Fusarium* causing wilt of pigeonpea. Phytopathologische Zeitschrift 100:300-311.

Fusarium acuminatum, *F. oxysporum*, and *F. solani* were commonly found in soils growing pigeonpea. Each of these species was found to cause wilt of pigeonpea. Survival studies revealed that the populations of these species were highest at 30% water-holding capacity of the soil and at a temperature between 20°C and 30°C. Addition of carbohydrates to the soil at a 1% rate caused decline in the population of these species within 2-3 weeks, but the decline was more pronounced in the case of soil amended with sucrose. Amending the soil with various nitrogenous sources at the rate of 0.94 mg N/g (w/w) air-dried soil indicated that ammonium sulphate and urea decreased the number of colonies of these species. In soil amended with sodium nitrate the population of *F. oxysporum* increased. As the C:N ratio was increased the number of colonies of these species declined in the soil.

476. SINGH, D.V., and MISHRA, A.N. 1976. Search of wilt-resistant varieites of red gram in Uttar Pradesh. Indian Journal of Mycology and Plant Pathology 6:89.

Some of the varieties of red gram, namely C-11, C-28, C-36, F-18, NP(WR)-15, NP-41, and T-17, which were earlier reported to be resistant or tolerant to wilt have proved to be susceptible. Some lines, Bori-192-12-5-1-2 and Bori-192-15-2-2-11-42, were moderately resistant.

477. SINGH, D.V., NATH, L., and KISHUN, R. 1978. Chemical control of bacterial leaf spot on pigeonpea. Pesticides 12:29-30.

The efficacy of 28 chemicals was evaluated in vitro against X. cajani. Nine inhibited growth of the bacterium and were tested further in the field. The best control was achieved with three applications at 10-day intervals of streptocycline (100 ppm) followed by Agallol-3 (2000 ppm) and thiram (2000 ppm).

478. SINGH, G.P., and HUSAIN, A. 1962. Production of pectic and cellulolytic enzymes by arhar wilt fungus. Current Science 31:110-112.

Studies on the role of enzymes in the pathogenesis of F. lateritium f.sp. cajani, the agent of pigeonpea wilt, revealed that the fungus produces cellulase as well as polygalacturonase in culture, and these may play a role in the disease syndrome.

479. SINGH, G.P., and HUSAIN, A. 1964. Presence of fusaric acid in wilt-affected pigeonpea plants. Current Science 33:287.

Fusaric acid was demonstrated chromatographically in all affected parts (roots, stems, and leaves) after mycelial and spore inoculation of susceptible variety T. 105 with a virulent isolate of F. lateritium f.sp. cajani.

480. SINGH, G.P. 1965. Studies on wilt of arhar. Ph.D. thesis, Agra University, Agra, Uttar Pradesh, India.

481. SINGH, G.P., and HUSSAIN, A. 1968. Role of enzymes in pathogenesis by Fusarium lateritium f. cajani. Indian Phytopathology 21:361-373.

Pectin mythyl esterase (PME), polygalaturonase, and cellulase were present in culture filtrates of F. lateritium f.sp. cajani in extracts of infected pigeonpea plants. Only PME was present in root and stem extracts of healthy plants.

482. SINGH, G.P., and HUSAIN, A. 1970. Role of toxic metabolites of Fusarium lateritium f. cajani (Padw.) Gord. in the development of pigeonpea wilt. Proceedings of the National Academy of Sciences of India, Section B 40:9-15.

Sterile culture filtrates of a highly-pathogenic isolate of F. lateritium f.sp. cajani induced irreversible wilting, maceration of stems, and browning of basal tissues of young pigeonpea cuttings. Although both heated and unheated culture filtrates produced wilting in cuttings, only the latter could cause maceration and browning. The wilt symptoms in the cuttings treated with heated culture filtrate were less severe. Fusaric acid was detected in infected pigeonpea plants.

483. SINGH, K., DAHIYA, B.S., CHOHAN, J.S. 1975. Evaluation of arhar (Cajanus cajan) germplasm lines against the sterility disease in the Punjab. Journal of Research, Punjab Agricultural University 12:327-328.

When 34 germplasm lines of pigeonpea were screened in 1973-74 against the pathogen (pigeonpea sterility mosaic virus) under field conditions, 2 of them (L-3 and P-4785) were resistant and 16 others were tolerant.

484. SINGH, K.P., and EDWARD, J.C. 1978. Gibberella associated with wilted plants of arhar with its asexual Fusarium stage. Allahabad Farmer 49:91-94.

Symptoms of the disease described on pigeonpea in the Allahabad area included abundant salmon-pink sporodochia and black, carbonaceous, apparently superficial, perithecia on the shoot surface near soil level. The two stages of the pathogen are described as the new species F. butleri and G. butleri. The fungus is compared with G. stilboides.

485. SINGH, K.P. 1980. The association of Gibberella udum with the wilted arhar plants recorded again. Indian Phytopathology 33:161.

During a routine survey for plant diseases, G. udum was found associated with wilted pigeonpea plants grown in the Fort area of Allahabad in September 1978. Further, in February 1979, the perithecial stage of F. udum was recorded on the base of the shoots of plants in a pigeonpea field at the Military Farm, Allahabad. On examination, the perithecia, asci, and ascospores resembled G. udum, the perfect stage of F. udum reported earlier. From the metereological data recorded for these periods, it seems reasonable to think that the perithecial development is favored by cloudy weather, high humidity, and a combination of low/high temperature.

486. SINGH, N., and SINGH, R.S. 1970. Development of wilt causing species of Fusarium in fungicide treated soils. Indian Phytopathology 23:545-552.

Autoclaved and unautoclaved field soils, artificially infested with F. oxysporum f.sp. vasinfectum, F. oxysporum f.sp. lini, and F. oxysporum f.sp. udum, were treated with 200 to 1000 ppm (w/w) of zineb, ferbam, thiram, captan and Rhizoctol-Combi. Vegetative growth and sporulation of these fungi in soil was determined after 15 days by plating on Czapek-Dox malachite green-captan medium and peptone-PCNB medium. Tolerance of the fungi to presence of fungicides differed with type and quality of fungicides, species of the fungus, and the autoclaved and unautoclaved condition of the soil. Within the same species hyphae and spores showed different degrees of tolerance to certain fungicides, such as captan, zineb, and Rhizoctol-Combi. Thiram and ferbam were the most inhibitory of all the fungicides tried.

487. SINGH, N., and SINGH, R.S. 1980. Inhibition of Fusarium oxysporum f.sp. udum by soil bacteria. Indian Phyto- pathology 33:356-357.

Bacillus subtilis (cultures B4, B6, B18, and B19) and B. cereus (culture B12) were found to inhibit growth and spore germination and cause some lysis of the mycelium and germ tubes of the test fungus F. oxysporum f.sp. udum. B. badius (culture B15) and Pseudomonas fluorescens (culture B20) neither inhibited the growth of F. oxysporum f.sp. udum nor brought about significant lysis of the growing mycelium. They had an inhibitory effect on spore germination.

488. SINGH, N.D., and FARRELL, K.M. 1972. Occurrence of Rotylenchulus reniformis in Trinidad, West Indies. Plant Disease Reporter 56:551.

The reniform nematode, R. reniformis, was isolated for the first time from the soil and roots of several crops (including pigeonpea) in Trinidad. The distribution and importance of this nematode to pigeonpeas and other crops in Trinidad has yet to be determined.

489. SINGH, N.D. 1975. Evaluation of nematode population in pigeonpea. Pages 147-149 in Tropical diseases of legumes (Bird, J., and Maramorosch, K.,

eds.). New York, USA: Academic Press.

The high nematode counts for Rotylenchulus reniformis and Pratylenchus spp, in particular, that were observed in three pigeonpea varieties, suggest a high degree of susceptibility to nematode attack.

490. SINGH, N.D. 1975. Studies on the selected hosts of Rotylenchulus reniformis and its pathogenicity to soybean (Glycine max). Nematropica 5:46-51.

Six plant species were tested for host suitability of R. reniformis. Tomato, pigeonpea, and watergrass supported large population increases but the nematode population declined under Bermuda grass (Cyanodon dactylon) after 10 weeks. Significant reductions occurred in dry weights of tops and roots and in the linear growth of infected soybean plants 8 weeks after transplanting into naturally-infested soil. Initial larvae populations of 500 and 1000 R. reniformis reduced the mean weights of roots by 14.7 and 53.7%, the tops by 37.0 and 54.7%, and linear top growth of soybean by 23.1 and 27.5%, respectively, when compared with noninoculated controls.

491. SINGH, N.D. 1975. Effect of oxamyl applications on eelworm penetration into roots of tomato, lettuce and pigeonpea. Tropical Agriculture 52:369-373.

In glasshouse tests a single foliar application of oxamyl of 2500 ppm inhibited significantly the penetration of pigeonpea seedlings by R. reniformis..

492. SINGH, P., VASUDEVA, R.S., and BAJAJ, B.S. 1965. Seed bacterization and biological activity of bulbiformin. Annals of Applied Biology 55:89-97.

In further studies at the Indian Agricultural Research Institute, New Delhi, maximum production of bulbiformin occurred on the seed coats, spermatosphere, and rhizosphere of pigeonpea treated with B. subtilis mixed with molasses solution and groundnut cake, reaching a peak in 15-18 days. The antibiotic becomes systemic in plant tissue and forms a protective zone round the roots of pigeonpea seedlings. In observations continued for 7 weeks after sowing, seed bacterization reduced the incidence of F. udum at this stage.

493. SINGH, R., and MALL, T.P. 1974. Studies on the nodulation and nitrogen fixation by infected leguminous plants. 1. Effect of arhar mosaic virus infection on nitrogen value, nodulation and nitrogen fixation by some pulse crops. Plant and Soil 41:279-286.

The effects of pigeonpea mosaic virus strains, ASM and AMM, on cowpea, mung (Vigna radiata), and urd (V. mungo) are described. Both strains reduced the growth and fresh weight of infected plants. Dry weight of infected V. radiata and V. mungo plants increased but that of cowpea decreased. The disease decreased the number, weight, and size of nodules in cowpea and V. radiata but increased the number and fresh weight in V. mungo. Total N in infected cowpea and V. radiata plants was lower than in healthy ones but was higher in V. mungo plants. The strains reduced the N-fixation capacity.

494. SINGH, R., and MALL, T.P. 1974. Effect of arhar mosaic virus on yield and chemical constitution of seeds of some legumes. Labdev Journal of Science and Technology 12B:145-149.

Pigeonpea mosaic virus strains AMM and ASM infection reduced the number, size, and weight of fruit and seeds of masur (Lens esculenta Moench), Kasuri methi (Trifolium carniculata L.) and methi (Trigonella foenumgraecum L.). Diseased legume plants have low reproductive capacity and poor seed germination in comparison with healthy plants. Nitrogenous fractions such as total nitrogen, protein, nitrate nitrogen, ammoniacal nitrogen, free amino acids, phosphorus fractions (total, inorganic, and organic) and total, reducing, and nonreducing water-soluble sugars and starch were higher in seeds of healthy plants than infected ones. Nitrite nitrogen and urease activity was greater in diseased seeds than healthy ones. Seeds from ASM-infected plants suffered greater loss than AMM-infected ones.

495. SINGH, R., and MALL, T.P. 1975. Effect of arhar mosaic virus infection on nodulation of pigeonpea. Indian Journal of Experimental Biology 13:322-323.

Nodule number, size, and fresh dry-weights increased with age in pigeonpea cv Sharda, but at a higher rate in healthy plants in comparison with plants infected by pigeonpea mosaic virus. The reduction was more severe in early-infected than in late-infected plants. The severe virus strain induced more reduction than did the mild one.

496. SINGH, R., and MALL, T.P. 1976. A new virus disease of arhar (Cajanus cajan [L.] Millsp.). Current Science 45:635-636.

Pigeonpea is an important pulse crop of India. In the early 1970s some plants of pigeonpea showed virus disease symptoms quite distinct from earlier ones. The new symptoms were of two types. In the first, the diseased plants showed mild mosaic mottling and slight distortion and reduction in the size of leaflets. Also, the affected plants were dwarfed and bore smaller fruits. The virus isolate obtained from this plant is termed AMM. The second new symptom consisted of irregularly scattered chlorotic and dark areas of varying shape and size. The leaflets were twisted and reduced in size. Plants were dwarfed and bore smaller and fewer pods. The virus isolate obtained from such a plant is termed ASM. Cross-protection tests indicated that AMM and ASM were related strains of a single virus. The paper reports this new sap-transmissible virus causing mosaic diseases in pigeonpea from India.

497. SINGH, R., and MALL, T.P. 1976. Effect of infection by arhar mosaic virus on the Hill reaction and primary productivity of pigeonpea (arhar) leaves. Indian Journal of Experimental Biology 14:376-377.

The effect of strains AMM and ASM of pigeonpea mosaic virus on the primary productivity of the Hill reaction in pigeonpea cv Sharda was to reduce the capacity of gross production per unit area and the rate of the Hill reaction, and to increase the respiratory loss at all stages of infection.

498. SINGH, R., and MALL, T.P. 1978. Changes in chemical composition of pigeonpea fruits due to arhar (pigeonpea) mosaic virus infection. Acta Phytopathologica Academiae Scientiarum Hungaricae 13:41-44.

Total N and protein were higher in fruit coats but lower in other fruit parts of diseased pigeonpea plants than in healthy ones. The percentages of nitrite, nitrate, and total free amino acids were higher in all parts of infected fruits than in healthy ones. Total and organic P fractions were lower in plants infected with mild strains than in those with severe strains of the virus, but the reverse was the case for inorganic P. The various carbohydrate fractions were higher in healthy pigeonpea fruits than in infected plants.

499. SINGH, R., and MALL, T.P. 1978. Effect of arhar (pigeonpea) mosaic virus on the yield and reproductive capacity of pigeonpea cultivars. Indian Journal of Mycology and Plant Pathology 8:178-181.

In field tests both the mild and the severe strains reduced the number, weight, and size of the fruits, seeds, and plant reproductive capacity, but the effect was more severe with the latter strain. Maximum yield loss occurred in cv Sharda, followed by Prabhat and T-17.

500. SINGH, R., and MALL, T.P. 1979. Chlorophyll and carbohydrate contents of a virus diseased pigeonpea plant. Indian Journal of Mycology and Plant Pathology 9:269-271.

The diseased pigeonpea leaves always have lesser chlorophyll content than their healthy counterparts. Similar results were also obtained with several host virus combinations. A lower content of carbohydrate (water-soluble total reducing and nonreducing sugars and starch) was recorded in infected plants than in the healthy ones. Such derangements in the carbohydrate contents due to virus infection have also been observed in other leguminous plants.

501. SINGH, R., and MALL, T.P. 1979. Screening of some chemicals for antiviral properties. Science and Culture 45:66-68.

Copper sulphate (2%), mercuric chloride (1%), and nicotine sulphate (50%), mixed with virus inoculum, completely inhibited infectivity of mild and severe strains of pigeonpea mosaic virus in pigeonpea plants. Some chemicals inhibited the different strains to different extents. Chemicals producing severe toxic effects on inoculated leaves were more potent inhibitors than those that were mildly toxic.

502. SINGH, R.A., and PAVGI, M.S. 1972. Some diseases of pigeonpea in Uttar Pradesh, India. FAO Plant Protection Bulletin 20:116-118.

Symptoms of wet leaf rot were characterized. Choanephora cucurbitarum was isolated and seedlings were successfully inoculated. Bacterial leaf spot and stem canker diseases were observed and a bacterium resembling X. cajani was associated with them. A wilt disease was frequently observed in early August, the agent being a Synchytrium closely resembling S. phaseoli-radiati. A leaf gall associated with an endophytic alga is newly recorded on pigeonpea. The upper surface of young leaves were studded with numerous, small solitary galls. Near soil leaves were more heavily infected and showed a bronze sheen.

503. SINGH, R.S., and SINGH, N. 1970. Effect of oil-cake amendment of soil on population of some wilt causing species of Fusarium. Phytopathologische Zeitschrift 26:160-167.

Autoclaved or unautoclaved field soil, reinfested with cultures of F. oxysporum f.sp. vasinfectum, F. oxysporum f.sp. udum, and F. oxysporum f.sp. lini was amended with 0.5-5.0% (w/w) of oil cakes of margosa, groundnut, or mustard. Plating done 15 days after amendment on two differential and selective media revealed that these oil cakes stimulate or inhibit vegetative growth or sporulation, or both, depending upon the species of the fungus, the quantity and quality of oilcakes, and the presence or absence of natural soil microflora. Growth and sporulation of the three species were increasingly enhanced by increased amounts of margosa cake, but high dosages of groundnut and mustard cakes were inhibitory.

504. SINGH, R.S. 1974. Effect of host and nonhost crop seeds on vegetative growth and sporulation of *Fusarium udum* in soil. Indian Phytopathology 27:553-557.

A study conducted in autoclaved and unautoclaved soil infested with the pigeonpea wilt fungus *F. udum* has shown that seeds of the host, as well as many nonhost legumes and cereals, enhance vegetative growth of the fungus within 96 h. The host seeds do not encourage sporulation of the enchanced mycelial growth. Graminaceous crop seeds are not as good a media as legumes for growth of the fungus. The implication of this behavior of *F. udum* in the presence of host and nonhost crop seeds, with regard to its survival in the soil, is discussed.

505. SINGH, S. 1981. Control of fungal deterioration of pigeonpea (arhar) seeds during storage. Seeds and Farms 7:41-42, 46.

Among the fungicides tested, Ceresan, thiram, captan, and Fytolan were found to be most effective in reducing storage molds at a concentration of 0.5% by weight. Ziram and Demosan, though, at this concentration, effectively reduced the total percentage of fungi but adversely affected the percentage germination of seeds.

506. SINGH, T.C.N. 1935. Sterility of crop plants and a study of their root system. Current Science 4:30-32.

An experiment to elucidate the possible physiological basis of sterility in pigeonpea is reported in a preliminary note. Irrigation of groups of sterile plants with solutions of various salts of potassium or sodium, and irrigation of the strong lateral roots of a further group with well water, was followed after a couple of weeks flowering. The groups of sterile plants showed no flowers.

507. SINGH, U.B. 1931. Studies in the genus *Cercospora*. Journal of the Indian Botanical Society 10:73-91.

A species of *Cercospora* was found on pigeonpea. It was characterized by obclavate, tapering hyaline to pale yellow conidia measuring 31-124 by 3-4 μ, and caused the development of irregular, raised spots mostly on the undersurface of the leaf, but sometimes also on the petioles and stem.

508. SINGH, U.B. 1934. Studies on *Cercospora indica*, new species parasitic on *Cajanus cajan* Spreng. Indian Journal of Agricultural Sciences 4:343-360.

The leaf spot disease of pigeonpea, caused by two strains of *Cercospora*, occurs commonly. The symptoms of the disease and the morphology are described. Between 20 and 25 °C infection occurs readily. Best growth of the strains takes places at 100% humidity. Both the strains have been found to belong to one species that has hitherto not been described. It is named C. indica.

509. SINHA, A.K. 1974. The use of a benomyl fungicide against Fusarium oxysporum f.sp. udum wilt of pigeonpea. Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz 81:571-574.

In pot tests seed dressing with Benlate against F. oxysporum f.sp. udum was ineffective and sprays were moderately effective only when applied to plants a few days before inoculation. Soil drenching, particularly before inoculation, gave better protection and was fairly persistent. At 100 ppm the fungicide prevented mycelial growth of the pathogen in vitro and at only 10 ppm it caused almost 50% inhibition.

510. SINHA, A.K. 1975. Control of Fusarium wilt of pigeonpea with Bavistin, a systemic fungicide. Current Science 44:700-701.

A soil drench with 4000 ppm Bavistin 10 days before inoculation with F. oxysporum f.sp. udum (F. udum) gave the treated pigeonpea plants total protection against the disease. Similar treatment with 2000 and 4000 ppm 5 days after inoculation were highly effective, and 4000 ppm given 22 days after also gave significant control. When used as a foliar spray the fungicide gave total protection at 10,000 ppm.

511. SINHA, M.K., and PRASAD, T. 1977. Deterioration of "arhar" seeds by Aspergillus flavus. Indian Phytopathology 30:70-72.

Deterioration in the contents (organic and amino acids and sugar) of pigeonpea seeds by A. flavus was investigated. Three soluble sugars, viz glucose, fructose, and sucrose, were detected in healthy seeds of which sucrose and fructose were completely utilized by A. flavus in infested seeds. The intensity of citric, tartaric, and oxalic acids increased in the diseased seeds in comparison with the healthy ones. Some of the amino acids completely disappeared in the infected seeds, whereas others appeared during incubation. The modifications in seed contents are discussed.

512. SINHA, M.K., ROY, A.K., and PRASAD, T. 1978. Reduction in total N content of arhar seeds due to storage fungi. Current Science 47:550-551.

Total N-content was lower in the infested than in healthy seeds. The deterioration in N content caused by A. niger was the highest in comparison with other fungi. The nitrogen is utilized by the fungi, and part of this is also converted into gaseous N .

513. SINHA, M.K., and PRASAD, T. 1979. Changes in seed contents of "arhar" (Cajanus cajan [L.] Millsp.) due to Curvularia lunata. Proceedings of the National Academy of Sciences of India, Section B 49:76-80.

Changes in sugars, starch, organic acids, amino acids and protein in arhar (Cajanus cajan L.) seeds due to infestation by Curvularia lunata were recorded. Qualitative analysis showed the presence of sucrose, glucose, fructose, citric acid, tartaric acid, and oxalic acid in varying concentrations under different incubation periods. Out of eight amino acids some disappeared while others either increased or decreased during the course of infestation. Qualitatively starch and protein showed continuous depletion

in their quantities during the incubation period.

514. SINHA, M.K., SINGH, B.K., and PRASAD, T. 1981. Changes in starch contents of arhar seeds due to fungi. Indian Phytopathology 34:269-271.

Aspergillus flavus, *A. niger*, *Alternaria alternata*, *Curvularia lunata*, *Drechslera hawaiiensis*, *Fusarium moniliforme*, and *Rhizopus nigricans* formed the dominant microfungi over pigeonpea seeds. Changes in starch contents of pigeonpea seeds by infesting the seeds with individual fungus, have been studied. A decrease in the starch content in general was noted, though the amount differed from species to species. *A. flavus* and *A. niger* brought about maximum decrease whereas *F. moniliforme* and *D. hawaiiensis* caused minimum reduction. Seeds from which the surface mycelium was not removed showed lesser decreases in starch content than those from which the mycelium was removed. The changes in starch content of the seeds due to fungal infestation have been discussed.

515. SLYKHUIS, J.T. 1980. Mites. Pages 325-356 *in* Vectors of plant pathogens (Harris, K.F., and Maramorosch, K., eds.). New York, USa: Academic Press.

Pigeonpea sterility mosaic disease is described in the chapter on Diseases probably caused by mites without an infectious agent.

516. SMALL, W. 1922. On the occurrence of a species of *Fusarium* in Uganda. Kew Bulletin (Miscellaneous Information) 9:269-291.

A full description is given of the cultural characters of the fungus on different media, as well as of a large series of cross-inoculations on different hosts, including pigeonpeas. The fungus is believed to be the same as *F. udum* from India.

517. SOMANI, R.B., WANGIKAR, P.D., and SHUKLA, V.N. 1975. A new stem canker and die-back disease of pigeonpea. Indian Phytopathology 28:436-437.

Colletotrichum capsici was found to cause stem canker, dieback, and corky splitting of the stem. The fungus was not *C. cajani*.

518. SOMANI, R.B., KHUNE, N.N., and WANGIKAR, P.D. 1981. Phoma stem canker: a new menace to arhar crop in Vidarbha. Pages 88-89 *in* Abstracts of papers of the Third International Symposium of Plant Pathology, 14-18 Dec 1981, New Delhi, India. New Delhi, India: Indian Phytopathological Society.

Stem canker of pigeonpea was first observed in the year 1976. Thereafter the disease has occurred regularly. It now threatens pigeonpea cultivation in the Vidharbha region of Maharashtra. The disease generally appears when the crop is about 2 months old. Infestation under field condition on cv C-11 from 1978-79 to 1980-81 is recorded. The percentage infection was 18.5 in 1978-79, 22.4 in 1979-80, and 38.0 during 1980-81. None of the cultivars was observed to be resistant. The pathogen was isolated and identified as *P. cajani*. The fungus is not seed-borne either externally or internally. Isolation from buried infested plant debris indicated that the fungus could survive up to 8 months and for a year on infested stem kept in open field.

519. SPENCE, J.A. 1975. The importance of diseases in relation to the grain legume research program in the eastern Caribbean. Pages 151-155 *in* Tropical

diseases of legumes (Bird, J., and Maramorosch, K., eds.). New York, USA: Academic Press.

A review of the diseases reported to affect pigeonpeas in the Caribbean region is given. Diseases of potential importance to the region caused by fungi are rust (Uredo cajani), canker (Phoma sp), S. rolfsii, Cercospora sp, and Fusarium sp., while those of virus or virus-like etiology are Rhynchosia mosaic and sterility disease.

520. SREENIVASAYA, M. 1932. Present position of the problem of spike disease. Cajanus indicus. Current Science 1:126.

The simplest and the readiest way of diagnosing spike disease is through its external symptoms. Communicability of the symptom from one plant to another is the criterion on which the infectious nature of the disease has been firmly established. In the regeneration plots the sandal plants associated with leguminous hosts (pigeonpea), which favor a rapid growth of the parasite, have succumbed to the disease.

521. SRIVASTAVA, A.K., and SINGH, R.B. 1978. Effect of pigeonpea mosaic virus on rhizosphere fungal flora of pea. Legume Research 1:92-96.

Pigeonpea mosaic virus infection increased the number of fungi in the rhizosphere and nonrhizosphere soil of diseased pea (Pisum sativum L.) cv Bonville. While no species was specific only to healthy rhizosphere, eight species were restricted only in the rhizosphere of diseased plants. The rhizosphere region of both the healthy and diseased plants had more fungi than did the nonrhizosphere region. Virus infection also increased the R/S ratio, peroxidase activity, and the amount of total nitrogen, but reduced the amount of total carbohydrate and catalase activity in diseased plants in comparison with their comparable healthy counterparts.

522. SRIVASTAVA, R.C. 1980. Fungi causing plant diseases at Jaunpur (UP). IV. Indian Phytopathology 33:221-224.

Of the 20 fungi reported, Mycovellosiella cajani is newly recorded in India on pigeonpea.

523. STEINER, G. 1960. [Three conferences about nematology] (In Es.) Miscellaneous Publication no. 32. Rio Piedras, Puerto Rico: Puerto Rico Agricultural Experiment Station. 41 pp.

Several species of the reniform nematode Rotylenchulus occur in the soils of Puerto Rico, and attack the roots of many crop plants grown there. Rotylenchulus spp frequently occur in large numbers around pigeonpea roots in Puerto Rico.

524. STEVENSON, J.A. 1917. Diseases of vegetable and garden crops. Journal of the Department of Agriculture, Puerto Rico 1:93-117.

A number of fungus diseases affect pigeonpea in Puerto Rico. One of the commonest is a leaf spot caused by Cercospora cajani. Diseased leaves are shed earlier than healthy ones. Although common, rust (Uromyces dolicholi) causes little damage. A serious canker disease that appears to be caused by a fungus has been observed in several localities on the island. Other fungi aid in the death and rotting of stems of mature plants, e.g., *Megalonectria pseudotrichia* and others in the same group.

525. STEVENSON, J.A. 1918. A check list of Puerto Rican fungi and host index. Journal of the Department of Agriculture, Puerto Rico 2:125-264.

The following fungi were isolated from the dead wood or bark of pigeonpeas in Puerto Rico: *Creonectria grammicospora*, *Megalonectria pseudotrichia*, and *Pleonectria megalonectria*. Also recorded from pigeonepea was *Uromyces dolicholi*, *Cercospora cajani*, and the parasitic alga *Cephaleuros virescens*.

526. SUBRAMANIAN, C.V. 1955. The ecological and the taxonomic problems in Fusaria. Presented at the Symposium on Soil Micro-organisms and Plant Well-being, Twentieth Annual Meeting of the Indian Academy of Sciences, Dec 1954, Belgaum, India. Proceedings of the Indian Academy of Sciences, Section B 41:102-109.

The pigeonpea wilt fungus (*F. udum*) is soil-borne on plant remains and it survives only on tissue which it colonizes as a parasite.

527. SUBRAMANIAN, C.V. 1955. Studies on south Indian Fusaria. IV. The "wild type" in *Fusarium udum* Butler. Journal of the Indian Botanical Society 34:29-36.

It is concluded that no fixed "wild type" concept can be formulated for *F. udum*.

528. SUBRAMANIAN, K.S., SAMUEL, G.S., JANARTHANAN, R., and KANDASWAMY, T.K. 1973. Studies on the varietal resistance of pigeonpea (*Cajanus cajan* L.) to sterility mosaic disease. Madras Agricultural Journal 60:38-40.

All 549 varieties studied were susceptible, but are classified in three categories depending on the severity of the virus infection observed.

529. SUBRAMANIAN, S. 1961. Studies on the wilt of pigeonpea. Ph.D. thesis, University of Madras, Madras, Tamil Nadu, India.

530. SUBRAMANIAN, S. 1961. Nutritional studies on *Fusarium udum* Butler. Proceedings of the Indian Academy of Sciences, Section B 54:295-305.

Data on growth and sporulation with 22 C and 13 N sources are tabulated. Glycerol was best for growth and lactic acid for sporulation. The possible formation of adaptive enzymes is suggested. The role of organic acids in the utilization of ammonium N and the effect of pH on that of nitrate N are noted.

531. SUBRAMANIAN, S. 1963. Fusarium wilt of pigeonpea. I. Symptomatology and infection studies. Proceedings of the Indian Academy of Sciences, Section B 57:134-138.

The pathogenicity of four isolates of *F. udum* was tested on six varieties of pigeonpea. NP-15 proved to be the least susceptible and it is suggested that no spores are produced in that variety as a result of the lack of a proper substrate in the root system or the action of some inhibitory substance in the xylem.

532. SUBRAMANIAN, S. 1963. *Fusarium* wilt of pigeonpea. II. Changes in the host metabolism. Proceedings of the Indian Academy of Sciences, Section B 57:178-194.

In healthy plants of the three varieties studied, content of chlorophyll, ascorbic acid, free reducing sugars, and total Mn were highest in the least susceptible variety, NP-15, and lowest in the most susceptible, NP-24. In NP-24, the roots contained more total carbohydrates than the shoots, whereas in NP-15 the reverse was true. The Fe:Mn ratio increased with increasing susceptibiilty. In inoculated plants, lower susceptibility was associated with a smaller reduction in chlorophyll, ascorbic acid, and total carbohydrates.

533. SUBRAMANIAN, S. 1963. *Fusarium* wilt of pigeonpea. III. Manganese nutrition and diseases resistance. Proceedings of the Indian Academy of Sciences, Section B 57:259-274.

Manganese amendment to the soil was found to reduce pigeonpea wilt considerably. In plants grown in inoculated soil with 80 ppm Mn, the pathogen colonized only in the roots. At 100 and 200 ppm there was complete exclusion of the fungus. Foliar sprays and presoaking of seeds gave even more encouraging results. The role of Mn in the mechanism of disease resistance is discussed.

534. SYDOW, H., and BUTLER, E.J. 1906. Fungi indiae orientalis. Part I. Annals of Mycology 4:424-445.

Rust on pigeonpea is reported from India for the first time.

535. TATHODE, M.N. 1975. Further studies on *Fusarium oxysporum* f. *udum* (Butl.) Snyder and Hansen causing wilt of pigeonpea (*Cajanus cajan* [L.] Millsp.). M.Sc. thesis, Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India.

536. TELIX, S. 1960. A list of *Cercospora* occurring in Mauritius, with short notes on the newly recorded species of some economic importance. Revue Agricole et Sucriere de l'Ile Maurice, 39:9-14.

Newly recorded *Cercospora* spp of economic importance, including *C. cajani* on pigeonpea, are list with notes.

537. THAKUR, R.N. 1973. Occurrence of *Fusarium* wilt of *Crotalaria verrucosa* in India. Indian Journal of Mycology and Plant Pathology 3:177-178.

Crotalaria tetragona is the new host for *F. udum* f.sp. *crotalariae*, and the occurrence of this fungus on *C. verrucosa* is the first record in India.

538. THEIS, T., FREYRE, R.H., and KENNARD, W.C. 1957. *Pellicularia filamentosa* on *Tephrosia vogelli* and *Cajanus indicus* in Puerto Rico. FAO Plant Protection Bulletin 5:159-160.

Control was obtained with Bordeaux mixture and zineb.

539. THIRUMALACHAR, M.J., PATEL, M.K., KULKARNI, N.B., and DHANDE, G.W. 1956. Effects in vitro of some antibiotics on thirty-two *Xanthomonas* species occurring in India. Phytopathology 46:486-488.

The antibiotics used showed varying degrees of inhibition of growth against all the Xanthomonas species tested. X. cajani is included in the 32 species.

540. TUCKER, C.M. 1927. Report of the Plant Pathologist. Report of the Puerto Rico Agricultural Experiment Station, 1925. pp. 24-40.

Rhizoctonia ferruginea from sugarcane caused severe damping-off in pigeonpea seedlings. Inoculations were done to other hosts. Experience showed the disease was more severe in dry soils. Pigeonpeas damaged each year by stem canker were associated with Botryosphaeria xanthocephala, reported as a saprophyte in India.

541. TUCKER, C.M. 1927. Report of the Plant Pathologist. Report of the Puerto Rico Agricultural Experiment Station, 1926. pp. 28-30.

In Puerto Rico pigeonpeas were attacked by an anthracnose disease caused by Colletotrichum cajani. Infection resulted in spotting of the pods and leaves and destruction of the seeds. Anthracnose attack was most serious during periods of heavy rainfall.

542. TUCKER, C.M. 1927. Pigeonpea anthracnose. Journal of Agricultural Research 34:589-596.

Colletotrichum cajani Rangel was found causing a rather common disease of pigeonpea in Puerto Rico. Spotting of the pods and leaves, blackening and shrinking of the veins, premature leaf fall, and distortion, abortion, and death of the pods are the chief symptoms. The losses are mainly due to the dropping of young pods and the discoloration and decay of some or all of the seeds in the affected pods. The amount of damage incurred increases with the age at which the crop is harvested. In January 1925 86.5% of pods were found to be infected, and the same gathering of pods yielded 36.3% of unmarketable seeds. The most important factor determining the amount of disease seems to be the moisture; infection is more serious in periods of heavy rainfall. The conidia are cylindrical, broadly elliptical or irregular, with rounded ends, and 12-17 by 3.5-7.2 μ in diameter. Setae are numerous on old pod spots but rare on the leaves, usually somewhat curved, septate, and averaging 100 by 3.5 μ. The cultural characters of the causal organism are briefly described. Steamed pigeonpea pods was the the only medium in which conidia were produced after 1 week. Appressoria, apparently analogous to chlamydospores, were observed after 2 months on potato-dextrose agar and steamed pigeonpea pods. Attempts to inoculate varieties of Phaseolus vulgaris susceptible to C. lindemuthianum with the pigeonpea fungus were unsuccessful.

543. UPADHYAY, R.S. 1979. Ecological studies on Fusarium udum Butler causing wilt disease of pigeonpea. Ph.D. thesis, Banaras Hindu University, Varanasi, Uttar Pradesh, India.

544. UPADHYAY, R.S., and RAI, B. 1979. Coprinus lagopus as potent saprophytic colonizer of pigeonpea in soil. Science and Culture 45:171-172.

In studying the competitive saprophytic ability of Fusarium udum on pieces of pigeonpea roots and stems in soil, C. lagopus was found to be constantly associated with F. udum and its fructifications were more frequent in the presence of pigeonpea substrates. C. lagopus was also frequently isolated from the rhizoplane of healthy and diseased pigeonpea plants.

545. UPADHYAY, R.S., RAI, B., and GUPTA, R.C. 1979. Formation of reproductive bodies by Fusarium udum within Cunninghamella echinulata during parasitism. Microbios Letters 11:69-75.

Interaction between F. udum and C. echinulata was investigated in dual cultures in vitro. F. udum parasitized the latter by direct penetration and caused lysis of the host hyphae. The formation of conidia and chlamydospores of the antogonist was also observed in the lumen of the host hyphae. C. echinulata is a new host recorded for F. udum.

546. UPADHYAY, R.S., RAI, B., and GUPTA, R.C. 1981. Fusarium udum as a mycoparasite of Mortierella subtilissima. Plant and Soil 60:149-151.

Fusarium udum was found to be a mycoparasite of M. subtilissima, which is a new record. Formation of chlamydospores by F. udum inside M. subtilissima was observed as a result of mycoparasitism.

547. UPADHYAY, R.S., and RAI, B. 1981. Effect of cultural practices and soil treatments on incidence of wilt disease of pigeonpea wilt. Plant and Soil 62:309-312.

The incidence of wilt disease of pigeonpea caused by F. udum under soil treatments with various substances was studied under field conditions. The disease incidence was highly suppressed under mixed cropping with Crotalaria medicaginea. Phygon XL was found to be the most effective fungicide to reduce the incidence of the disease. The incidence of wilt disease also decreased in the case of soil amended with the leaves of C. medicaginea. Wilt incidence increased in the soil amended with the roots of pigeonpea.

548. UPADHYAY, R.S., RAI, B., and GUPTA, R.C. 1981. Fusarium udum parasitic on Aspergillus luchuensis and Syncephalastrum racemosum. Plant and Soil 63:407-413.

Mycoparasitic behavior of the pigeonpea pathogen F. udum on the two soil fungi is described.

549. UPPAL, B.N., and KULKARNI, N.T. 1935. Fusarium wilt in Sann hemp. Current Science 5:314-315.

Cultures of Fusarium vasinfectum from sunn hemp did not infect pigeonpea and viceversa, though the control plants in all cases showed a high degree of deaths. These results do not confirm those reported by Mitra (see, for instance, item 301).

550. (Deleted.)

551. UPPAL, B.N. 1937. Summary of work done under the Plant Pathologist to the Government, Bombay Presidency, Poona. Report of Department of Agriculture, Bombay, 1935-36. pp. 203-207.

Oidiopsis taurica was found on pigeonpea, apparently for the first time in India.

552. UNITED SATES DEPARTMENT OF AGRICULTURE. 1952. List of intercepted plants pests, 1951. Washington, D.C., USA: USDA. 61 pp.

Colletotrichum cajani (Glomerella cingulata) is reported on pigeonpea from Puerto Rico.

553. VAHEEDUDDIN, S. 1955. Phytopathological survey of the Hyderabad state. Indian Phytopathology 8:166-171.

Wilt disease of pigeonpea was observed in the Nanded, Bhir, Sangareddy, and Mahabubnagar areas.

554. VAHEEDUDDIN, S. 1956. Selection of tur (Cajanus cajan L.) resistance varieties against (Fusarium udum Butler). Agricultural College Journal, Osmania University 3:12-13.

High-yielding selections have been made that show high wilt resistance.

555. VAHEEDUDDIN, S., and NANJUNDIAH, S.M. 1956. Evolving wilt- resistant strains in tur (Cajanus cajan L.). Proceedings of the Indian Science Congress 43(4):20. (Abstract.)

A wilt-sick field was created by spreading compost made of wilted plants. Pigeonpea was grown in this field and a systematic selection of plants was made year after year. Later, the work was continued only on the selected plants and their progeny that were found resistant. By 1949 three lines showing resistance to the extent of 80-90% were isolated. In each year care was taken to see that the plot was thoroughly infested with wilt (F. udum) and that material to be tried was flanked by susceptible local varieties to serve as control. Three strains--ST-1, ST-2, and ST-3--were isolated, showing a range of resistance from 30 to 90%.

556. VAHEEDUDDIN, S. 1958. Evolving wilt resistant strains in redgram. Andhra Agricultural Journal 5:163-164.

Out of a large number of pigeonpea strains tested, C-11, C-28, and C-36 proved superior in yield and wilt resistance. The names of these strains have been changed to ST-1, ST-2, and ST-3, respectively.

557. VAKILI, N.G., and MARAMOROSCH, K. 1974. "Witches'-broom" disoase caused by mycoplasma-like organisms on pigeonpea (Cajanus cajan) in Puerto Rico. Plant Disease Reporter 58:96.

The mycoplasma-like organism associated with the disease was positively identified and later observed under the electron microscope. Intensive efforts should be made to find local sources of resistance and develop resistant cultivars. Leaf hoppers (Empoasca spp) are most probably the insect vectors that transmit the disease from plant to plant. A possible method to reduce the cost of insecticide applications, as well as to ensure a disease-free crop, is to develop varieties that combine resistance to witches' broom with resistance to leaf hoppers.

558. VAN VELSON, R.J. 1961. Witches' broom on pigeonpea induced by mealybug (Planococcus); i.e., Pseudococcus citri infestation. Journal of Papua New Guinea Agriculture 14:129.

559. VASUDEVA, R.S. 1949. Soil-borne plant diseases and their control. Current Science 18:114-115.

The antagonism of B. subtilis and F. udum is described.

560. VASUDEVA, R.S., and ROY, T.C. 1950. The effect of associated soil microflora on Fusarium udum Butl., the fungus causing wilt of pigeonpea (Cajanus cajan [L.] Millsp.). Annals of Applied Biology 37:169-178.

Inoculation with F. udum produced more wilt of pigeonpea in sterilized than in unsterilized soils at the same pH from unsterilized soils with low disease incidence. A fungus, B. subtilis, and an Actinomyces were isolated. The interaction of F. udum and other organisms isolated was studied. The low wilt incidence in unsterilized soils may result from the inhibitory activity of the associated microflora in the soil.

561. VASUDEVA, R.S., JAIN, A.C., and NEMA, K.G. 1952. Investigations of the inhibitory action of B. subtilis on F. udum, the fungus causing wilt of pigeonpea. Annals of Applied Biology 39:229-238.

A suitable basic medium for the growth of B. subtilis, particularly in relation to the production of an antibiotic inhibitory to F. udum, is described. MgS04, Mn, and Fe are found to increase the production of the antibiotic. The active principle is absorbed by soil and, to a lesser degree, by kaolin. The organic matter and the soluble salts in the soil do not appear to play an important role in the loss of activity of the filtrates during their passage through a bed of soil.

562. VASUDEVA, R.S., and GOVINDASWAMY, C.V. 1953. Studies on the effect of associated soil microflora of Fusarium udum Butl., the fungus causing wilt of pigeonpea (Cajanus cajan [L.] Millsp.) with special reference to its pathogenicity. Annals of Applied Biology 40:573-583.

Aspergillus niger and B. subtilis, strain A, inhibited F. udum.

563. VASUDEVA, R.S. 1955. The effect of associated soil microflora of Fusarium udum Butl. on the causing of wilt of pigeonpea (Cajanus indicus). Proceedings of the Sixth International Congress of Microbiology 5:239-242.

564. VASUDEVA, R.S. 1958. Report of the Division of Mycology and Plant Pathology. Scientific Reports of the Indian Agricultural Research Institute, 1955-56. pp. 85-104.

Pigeonpea varieties C-15 (W.E.), P3, and P48 proved resistant to wilt (F. udum) while N.P. 41 became susceptible for the first time after 12 years. F. udum was reduced in severity when pigeonpeas were grown in soil to which B. subtilis antibiotic had been added.

565. VASUDEVA, R.S. 1958. Report of the Division of Mycology and Plant Pathology. Scientific Reports of the Indian Agricultural Research Institute, 1956-57. pp. 86-100.

Pigeonpea cultivar S-55 developed 5.3% infection with F. udum wilt in pots but none in the field.

566. VASUDEVA, R.S., SUBBAIAH, T.V., SASTRY, M.L.N., RANGASWAMY, G., and IYENGAR, M.R.S. 1958. "Bulbiformin", an antibiotic produced by Bacillus subtilis. Annals of Applied Biology 46:336-345.

An antibiotic is chiefly antifungal. Its presence leads to the formation of characteristic bulbs in the spores and hyphae of the test fungi. The active principle is thermolabile. It is suggested that the antibiotic under consideration is different from those of B. subtilis previously described. The name therefore proposed for this antibiotic is bulbiformin. It is effective against F. udum.

567. VASUDEVA, R.S., SINGH, G.P., and IYENGAR, M.R.S. 1962. Biological activity of bulbiformin in soil. Annals of Applied Biology 50: 113-119.

A soil amendment study in pots gave striking wilt reduction. Bacillus subtilis is capable of producing the antibiotic bulbiformin in soil. Antibiotic production is considerably enhanced when the the soil is sterile and enriched with such nutrients as aspartic acid or asparagine, and dextrose or certain root residues. In the presence of the root supplements the antibiotic persists in soil over several weeks in fairly high concentrations. Under favorable conditions for antibiotic production, such as the presence of root residues, soil inoculation of B. subtilis results in a marked reduction in the incidence of pigeonpea wilt due to F. udum.

568. VASUDEVA, R.S., SINGH, P., SEN GUPTA, P.K., and MAHMOOD, M. 1963. Further studies on the biological activity of bulbiformin. Annals of Applied Biology 51:415-423.

Amendment of soil with roots of certain leguminous crops, molasses, and oil cake markedly increased the production of antibiotic by B. subtilis. A soil amendment consisting of a combination of groundnut cake and molasses was about 5 times more effective than a dextrose amendment in increasing the production of bulbiformin and also favored its persistence in the soil. The antibiotic was found to act systemically and to be nonphytotoxic when taken up by the roots of pigeonpea in a pot experiment. Inoculation of B. subtilis into autoclaved soil amended with molasses, sweet clover roots, and groundnut cake reduced by 88% the incidence of pigeonpea wilt caused by F. udum.

569. VEERASWAMY, R., RANGASWAMY, P., and SHERIFF, N.M. 1975. CO.2 redgram--a new strain with early maturity and improved plant type. Madras Agricultural Journal 62:541-543.

Pigeonpea CO.2 is a compact, erect plant suited for mixed cropping with groundnut. It matures in 100-115 days and is capable of yielding 1500 kg/ha under irrigation and 750 kg/ha under rainfed conditions. Productivity per day is also high. The line is photoinsensitive and fairly tolerant of Fusarium and Rhizoctonia wilt and root-rot diseases under field conditions.

570. VENKATARAM, C.S. 1955. Soil Fusaria and their pathogenicity. Proceedings of the Indian Academy of Sciences, Section B 42:129-144.

Investigations were carried out in Madras on Fusarium spp causing disease of cotton and pigeonpea. These included identity of species, distribution in 11 fields, and pathogenicity. F. vasinfectum and F. udum were included in studies.

571. VENKATESWARLU, S., REDDY, A.R., SINGH, R.M., and SINGH, R.B. 1980. Reaction of pigeonpea varieties to wilt and sterility mosaic. Tropical Grain Legume Bulletin 17-18:25-28.

Ninety elite and diverse lines of pigeonpea, including some commercial varieties, were planted in single-row plots in a well established wilt-sick plot of the Pulse Research Block of Banaras Hindu University during the 1978 cropping season. Twenty seedlings were maintained in each line. After every 10 lines, one line of a wilt-susceptible check (1258) and one line of a sterility mosaic (SM) susceptible check (BDN-1) were planted as infector rows. Wilt scoring was done at flowering and maturity. Wilted plants were labeled after the first observation. SM-infected leaves from the susceptible check were stapled to the young leaves of 50-day-old seedlings in each line. Observations were recorded on each line after 20 days of stapling for SM.

572. VENKATESWARLU, S., and SINGH, R.B. 1980. Pigeonpea improvement at Banaras Hindu University. Tropical Grain Legume Bulletin 17-18:28-29.

Pigeonpea wilt (F. udum) and sterility mosaic (SM) are the most serious diseases of this locality. Screening of our germplasm in a well established wilt-sick plot resulted in identifying 13 lines free from this disease. Screening germplasm lines by the infector-row and leaf-stapling techniques for SM helped in identifying 28 lines with a high degree of resistance. Fortunately one of these lines (Purple-1) has a very high degree of multiple resistance to both wilt and SM and it also provides yields up to 1500 kg/ha in about 200 days. This line has been tested by pulse pathologists of the All India Coordinated Pulse Improvement Project as well as by pulse pathologists at ICRISAT.

573. VENKATESWARLU, S., REDDY, A.R., CHAUHAN, V.B., SINGH, O.N., SINGH, R.M., and SINGH, U.P. 1981. A promising resistant line of pigeonpea (Malaviya arhar-1) for wilt and sterility mosaic (virus?). Tropical Grain Legume Bulletin 23:27-29.

This screening has resulted in the identification of 8 lines resistant to sterility mosaic and 14 resistant to wilt, of which 13 lines have multiple resistance to both diseases. The most promising among the multiple-resistant lines is Purple-1 (Malaviya Arhar-1).

574. VENKATESWARLU, S., REDDY, A.R., SINGH, O.N., and CHAUHAN, V.B. 1981. Alternaria blight: the most serious disease of postrainy-season (rabi) pigeonpeas. International Pigeonpea Newsletter 1:28-29.

Yellow mosaic and Alternaria blight are the two important diseases of postrainy-season (rabi) pigeonpeas of which the latter is the most serious in northeastern India. Bahar variety showed 100% infection, whereas four entries--MA-128-1, MA-128-2 (from BHU), DA-2 (from Dholi), and 20-105 (from West Bengal)--were free of symptoms.

575. VERMA, A.K., and KAMAL. 1979. An investigation on mycoflora of air over arhar (Cajanus cajan [L.] Millsp.) fields. 1. Aspergilli (Aspergillus spp) over pigeonpea. National Academy Science Letters (India) 2:370-374.

576. VERMA, A.K., and KAMAL. 1980. Air-spora studies over arhar (Cajanus cajan [L.] Millsp.) field - periodicity in the spores of Drechslera, Epicoccum, and Penicillium. National Academy Science Letters (India) 3:13-17.

Data are presented on the air-spora over a pigeonpea field. Drechslera and Epicoccum spp were at maximum concentration during the winter months (cold and dry) while Penicillium was maximum in the wet, warm season.

577. VERMA, G. 1955. Mixed cropping with arhar. Agriculture and Animal Husbandry in Uttar Pradesh 6:70-80.

Experiments conducted on wilt-sick soil with a wilt-susceptible variety of pigeonpea, sole-cropped as well as intercropped with sorghum at the Central Research Farm, Kanpur, have repeatedly shown a marked reduction in the incidence of wilt in plots that are intercropped.

578. VIDHYASEKARAN, P., and ARJUNAN, G. 1976. A new redgram pigeonpea variety resistant to root rot (Macrophomina phaseolina). Madras Agricultural Journal 63:175-176.

Pigeonpea S-18 was found to be resistant to both root rot and wilt diseases.

579. VIEGAS, A.P. 1945. Some fungi of Brazil. V. Basidiomycetes—Auriculariales. (In Pt.). Bragantia 3:197-212.

This further instalment of the author's critically annotated list of Brazilian fungi includes, inter alia, Helicobasidium compactum on Inga sp, Hybanthus atropurpureus, and Urtica sp, Septobasidium castaneum associated with an undetermined insect on cassava cv Olandy and with Aspidiotus symbioticus on Ficus sp; S. fuscum with coccids on lime and orange; S. lepidosphais with coccids on orange; S. pseudopedicellatum with unspecified insects on orange and lime, with coccids on citron, orange, and Aleurites fordii, but on pigeonpea no insect symbiont is mentioned.

580. VIEGAS, A.P. 1961. Index of fungi of South America. Campinas, Brazil: Instituto Agronomico, Secao de Fitopatologia. 921 pp.

Twenty-three genera of fungi that have been recorded from pigeonpea in South America are listed. Included are the synonyms for some of the fungi.

581. VIENNOT-BOURGIN, G. 1959. Uredinales of Africa - Uredinales of Ivory Coast (In Fr.). Encyclopedie Mycologique 31:137-248.

Uromyces dolicholi is included, of which a description and diagnosis is given.

582. WALLACE, G.B. 1930. Mycological work. Report, Department of Agriculture, Tanganyika 1928/29. pt.2. pp. 35-36.

Some new records of Cercospora cajani and Oidiopsis taurica on pigeonpea are reported from Tanzania.

583. WALLACE, G.B. 1932. Tanganyika territory fungus list. Recent records. 10. Mycological Circular, Department of Agriculture, Tanganyika 23:1-5.

Fusarium lateritium var uncinatum was isolated from pigeopea roots, collars, and stems. Reinoculation caused the death of two seedlings.

584. WALLACE, G.B. 1932. Report of the Mycologist. Report, Department of Agriculture, Tanganyika, 1930. pp. 53-55.

Nematospora coryli was found in the seeds of pigeonpea.

585. WATERSTON, J.M. 1944. Plant pathology. Report, Department of Agriculture, Bermuda, 1943. pp. 7-8.

New host records include Sclerotinia sclerotiorum on pigeonpea pods.

586. WELLMAN, F.L. 1972. Tropical American plant diseases. Metuchen, New Jersey, USA: Scarecrow Press.

Witches' broom symptoms on pigeonpea were observed in El Salvador. Inoculation studies with insects, fungi, and bacteria from diseased plants did not reproduce the disease.

587. WIEHE, P.O. 1939. Division of Plant Pathology. Report, Department of Agriculture, Mauritius, 1938. pp. 34-39.

An outbreak of pigeonpea wilt disease was found to be caused by Gibberella fujikuroi var subglutinans.

588. WILLIAMS, F.J., GREWAL, J.S., and AMIN, K.S. 1968. Serious and new diseases of pulse crops in India in 1966. Plant Disease Reporter 52:300-304.

A new yellows symptom (yellow mosaic) on pigeonpea, probably of virus origin, and an apparently new fungal wilt (Phytophthora sp) of pigeonpea are among the diseases noted.

589. WILLIAMS, F.J., AMIN, K.S., and BALDEV, B. 1975. Phytophthora stem blight of Cajanus cajan. Phytopathology 65:1029-1030.

A new stem blight disease of pigeonpea was first observed in experimental plots in 1966 and was epiphytotic at New Delhi in 1969. The symptoms are dark brown to black lesions that partially or entirely encircle the stem at the base. The pathogen appears to be an undescribed Phytophthora sp.

590. WILLIAMS, F.J., and ALLEN, D.J. 1976. Pigeonpea diseases. Page 58 in Pathology: Grain Legume Training Course, 16 Aug to 26 Nov 1976. Ibadan, Nigeria: International Institute of Tropical Agriculture.

Pigeonpea appears to be relatively disease-free in Africa. In Nigeria the only disease of consequence is leaf rust, caused by Uredo cajani. Cercospora leaf spot (Cercospora cajani) occurs at IITA. Virus-like symptoms are rare. In East Africa, Fusarium wilt, powdery mildew (Leveillula taurica), and a leaf spot (Mycovellosiella cajani) may occasionally assume economic importance.

591. WOLLENWEBER, H.W. 1938. [Fusaria of pigeonpea, Cajanus cajan.] (In De.). Arbeiten aus der Biologischen Reichsanstalt fur Land-u-Forstwirtschaft 22:339-347.

An expanded Latin diagnosis is given for F. lateritium var uncinatum. Held in pure culture since its isolation from pigeonpea in 1905 by Butler, it is still pathogenic, giving a brown basal rot. This fungus attacks pigeonpea only, and appears less serious than wilt caused by F. udum.

592. YEH, C.C., TSCHANZ, A.T., and SINCLAIR, J.B. 1981. Induced teliospore formation by Phakopsora pachyrhizi on soybeans and other hosts. Phytopathology 71:111-112.

Telia and teliospores of this soybean rust were formed on Pachyrhizus erosus (yam bean), pigeonpea, wild soybean, etc., when these hosts were inoculated and grown in a growth room programmed for a 12-h photoperiod at 60-100% relative humidity and a maximum day temperature of 24 $\pm$1°C and a minimum night temperature of 15 $\pm$1°C.

593. YOGESWARI, L. 1948. The element nutrition of fungi. I. The effect of boron, zinc, and manganese on Fusarium species. Proceedings of the Indian Academy of Sciences, Section B 28:177-201.

The nutritional physiology of F. udum and other species was studied. Media with a high C:N ratio were favored by the fungus. The optimum pH for growth was 5.0. For F. udum 0.5 ppm of Bo, Zn, Mn was optimum. Higher concentrations were toxic. A combination of elements was better than individual elements alone.

594. ZAUMEYER, W., and THOMAS, H.R. 1957. A monographic study of bean diseases and methods for their control. Technical Bulletin no. 868. Washington, D.C., USA: United States Department of Agriculture. 255 pp.

In greenhouse inoculation tests, pigeonpea was one of many legumes susceptible to bean yellow mosaic virus.

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